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MONOPOLY AND PROGRESS.

By Dr. Franz Erich Junge-Hermsdorf.

III. STATE POWER AND ITS RELATION TO INDUSTRIAL POLICY IN GERMANY.

In this issue Dr. Junge brings to a close, for the present, his remarkable comparative study of American and German industrial policies and methods. His insight into affairs is obtained by thorough knowledge of his subject. His interpretation of German institutions, while inspired by the true affection of a patriot, acknowledges clearly the influence of special conditions and traditions upon their efficacy, and the limits to their application elsewhere. With these admissions, he suggests their possible adaptation to the certainly difficult situation confronting the manufactures and commerce of the United States.—THE EDITORS.

NOTHING common to man is foreign to nations. The story of the prodigal son applies to families as well as to communities. Thus in every people there is a natural inclination to prodigality, but not every nation has a benevolent father ready to kill a fatted calf, if waste and destruction have depleted its natural inheritance. Germany is not a rich man's heiress. She must prepare her children for adversity, not for prosperity, must fit them for the lean years which are near, not for the fat years that are promised in the future. Thus and thus only will they be able to conquer the racking times which are approaching.

Hence to the prime rule of *strategic expediency* dominating our national household, is coupled the other no less important consideration of *national economy*, urging upon authorities the supreme duty of guarding the country's irreplaceable resources, material and other, which joined with the subtle factor of civic virtue are the pillars of every commonwealth. Having to support sixty-five million active people on a territory four-fifths the size of Texas, and being fully aware of our geographical limitations, of the precariousness of our central situation, of the scarcity of raw materials at our avail, of our

dependence for certain supplies on foreign markets, and of the fact that in times of war they will be cut off by our adversaries—scientific administration and rational utilization of materials, emancipation from foreign support, the development of high-grade industries and agriculture, and the exchange of grey matter for raw matter, are natural correctives of our limited opportunities and logical directives for the industrial and commercial policy of the Empire.

Leaving aside the political argument and speaking more particularly of the attitude of the State, the present policy of Germany can be shortly defined as one of mutual partnership or co-operative nationalism, the State and its government attending to the more general and ideal, and the private individual to the more special and material ends of the national business. In spite of democracy pressing from without and of evolutionary philosophy pressing from within, there is a growing tendency on the part of the masses to rely on the State for support and inspiration, making the national government both co-active and co-responsible for their welfare. And even among conservative statesmen, the leaning, today, is far more in the direction of State socialism than in the direction of democracy.

This leaning on the paternal State is not wholly the result of modern tendencies. It is a result, in part, of the traditional policy of the Hohenzollern, radiating from Prussia ever since they took over the control of affairs in that country. It was the proud boast of Frederick the Great that he was *le roi des gueux*. Of all the governments of the seventeenth century, the Prussian was the first to seek the welfare of the whole community. The "Landrecht" recognizes the State as the protector of the poorer classes, and the supply of sustenance and work for those lacking means and opportunity of earning a livelihood as one of its duties. It was upon these clauses that Bismarck relied when, on May 7, 1884, he declared to the Reichstag his recognition of the laborers' right to work. His idea of social reform, of the nationalization of railways, of State monopolies in brandy and tobacco (not realized), even of the return to protection, all spring from his profound conviction that "many measures which we have adopted to the great blessing of the country are socialistic, and the State will have to accustom itself to a little more socialism yet." (1882.)

In this age of monopoly, when under the sway of commercialism the empire of business in all countries is encroaching upon national Governments, anxious to seize their privileges without burdening itself with their responsibilities, the blessing of a paternal policy for

the weal of the State is making itself especially felt. In reflecting upon American conditions, in this relation, it should be borne in mind—as distinguishing between our respective constitutional confederate systems—that in Germany every one of the twenty-six States is really a sovereign agency rendering public service, not merely "a government or administrative district" (W. Willoughby).

In Germany transfer of function from State to Federal authority means no more than a change in the site of the authority. The same functionaries who acted under State authority continue to act under Federal authority. Whether State or Nation should serve as public agency is, therefore, only a question of administrative expediency, not of principle rights. History and Constitution provide both Federal and State governments with adequate powers to cope with and regulate, in the name of the sovereign nation itself, the empire of business; while in the United States, business has become a power as great and greater than the nation in its scope and consequence—"a colossus which stands amid a confused variety of States and statutes, uniform, concentrated, poised upon a single plan, governed not by votes but by commands, seeking not service but profits." (Woodrow Wilson.)

In Germany private monopoly could never reach such gigantic proportions, because at the very outset of the industrial age a big slice of the national assets was withdrawn from private enterprise by the Government, being reserved exclusively for public uses and operated on a strictly socialistic basis for the equitable good of all. The other and major portion of the basic resources was, of course, left to exploitation and improvement by private initiative. In the course of time and under the influence of the economic revolutions in the neighboring European countries, especially England (Smith) and France (Colbert), the attitude of the State towards industry has, naturally, undergone various changes. But today the general tendency, under the pressure of the socialistic vote, is stronger than ever before for an expansion of national coöperation under the leadership of State or national government—representing a compromise, as it were, between the mercantilistic and the physiocratic doctrines, between the individualist and collectivist schemes—an attempt to infuse the cold reasoning of reckless commercialism and the utopian dreams of extreme socialism with the nobler motives of national expediency.

While the *authority* of the State is invariably supreme, its *functions* are of the progressive variety, establishing the balance between

all the productive and destructive forces of the land. The State not only partakes in every form of private industry, engaging part of the three factors of production—nature, labor and capital—but it extends its intervention in proportion to the growing needs of the Commonwealth. Its functions of *service* are quite as marked as its functions of *restraint,* and, with the standard of German citizenship on the ascendant, there is, indeed, a tendency of diminishing restraint and of increasing service.

Concisely defined, the State has to perform the following internal activities: (1) the framing of special laws serving various economic needs (agricultural, industrial, commercial, financial, banking, trades, etc), and the adjustment of the general and more especially of the civil law to these measures; (2) the performance of acts serving to eliminate obstacles or restraints hampering individual, associated, or other activity, and provision of measures fostering productivity, commerce, trade at home and abroad, whenever the efforts of individuals or groups fail to bring about the desired effect; (3) the taking over of business enterprises by the State or by communities, as far as these enterprises cannot be efficiently operated by private action, or are apt to lead to plundering of the public and other disastrous results; (these include the postal service, comprising telegraphs, telephones, parcels post; and further, railroads, a number of mines, smelting plants, factories, mills, forests, and farms); (4) the enactment of legal provisions for the protection of the poorer classes against extortion by the richer, of consumers by producers, and for the general betterment of the people's welfare (factory legislation, workingmen's insurance against sickness, accident and old age, inspection of houses, of food, regulation of competition, the State co-operating as far as possible with private philanthropic institutions).

Nor are the above all the functions which the State in Germany has to perform. Its powers, it was said, are progressive and practically unlimited. If higher political interests should so demand, the State may nullify any act of the people or of the people's representatives, may cancel even private property—with due compensation of the owners—if the public and human rights of the situation are deemed superior in sanctity to fixity of tenure. ("Staatsnotrecht.") In short, the State government in Germany is equalled in power and irresponsibility only by the judiciary (Supreme and Commerce Courts) of the United States. Those interests, be they aristocratic or plutocratic, which control the composition of either body, dominate the country, it being immaterial whether we call ourselves monarchical or democratic.

From the Middle Ages on, when imperialism was changed to nationalism, and more especially since 1850, when constitutional government was established in Prussia, the political influence exercised from the many up is quite as marked as the influence from the one down. The latter is indispensable because we do not care to impair the homogeneity of our race by foreign influx, and because the great mass of our people are a slow-acting body, needing direction and stimulus in order to move. It is amusing for one who possesses comparative insight to hear foreigners talk of "tyrannical domination" and "one-man power" in Germany, where property and capital are so much more equitably distributed than anywhere else, and where every one of our later-day reforms savors of socialism. In fact, even the emancipation of the peasantry, which was inaugurated as a result of the Stein-Hardenberg legislation—being an agrarian reform when the State took land from one person and gave it to another—was a much stronger form of state-socialism than was any of the above mentioned Bismarckian reforms, or as would be, for example, a complete nationalization of the mining industries.

The question of conservation and economy in the administration and utilization of irreplaceable resources being the dominant issue of the hour in the Union, and surely one of the gravest questions for the life of any nation, it is important to study the attitude of the State toward this concrete problem somewhat more closely. All mineral resources in the German Empire are "regalia," as they once were in the Roman Empire, it being the prerogative of the State to preserve or to exploit the mineral treasures of the land in a manner and at a rate best suited to the common concern. While the attitude of the State in this relation may change—for instance, a leasing system being preferred at one time and a selling system at another, as industrial conditions may require—the State yet always possesses the regal ownership of these resources—the right to take alike by escheat and forfeiture, the title to legislate in a manner which will reserve the exclusive right of the production and sale of minerals to the public, if private enterprise should disregard national needs, stand as a bar to progress, or, in any way, operate against the best interests of the public.

Thus on June 18, 1907, a law was passed in Prussia reserving the searching and mining of coal and salts exclusively to the State. On May 25, 1910, the now famous "Kali law" was enacted, regulating the production, delivery, and price of potash salts, and there are, of course, quite a number of laws pertaining to the social side of mining

industries, because mine workers, on account of the special hardships and dangers to which they are exposed, deserve the special care of a beneficent government.

Now, if the State owns and produces a sufficient percentage of some commodity, for instance, the coal, the Government can, of course, regulate and control the market, preventing cornering, demoralization, and slaughtering of prices, by offering its products at a lower price than the syndicate or withdrawing them from the market, as the case may be. Unfortunately, in the case before us, the Prussian State produces only about 20 million tons, or 10 per cent of the total output of coal, an amount which is almost completely absorbed in State iron and steel works, railroads, the navy, and other public institutions; so that regulation by competition is impossible unless the sphere of the State's activity is extended.

This policy of extending the State's activity as a supplier of raw materials commends itself for various reasons. It is technically practicable, commercially feasible, and financially profitable. It increases the controlling power and the stable revenues of the Government, without necessitating the levying of new taxes on the people, for which it is always hard to find a majority. But whether the immediate future in my country, under the pressure of socialism, will see more competition between public and private enterprises, or whether, under the pressure of capital, Government will limit its interference to an extension of control of private business by multiplication of statutes, cannot now be foretold. Personally I prefer the first mode to the second, because the latter must inevitably lead to a multiplicity and complexity of laws, which is already a crying nuisance of our generation, resulting in a general disregard of the sanctity and authority of the law.

This conviction is deepened when we contrast with the above outlined system of conservation and operation in Prussia, the chaos of uncertainties which seems to exist in the legal jungle of the United States, especially in the land and mining laws. Here is rich spoil for lawyers and corporations who fatten under their rule, defeating —by a bewildering contrariety of conflicting decisions—every effort on the part of the people to amend existing evils, and making a radical reform impossible as long as the vested rights and contracts of corporations are deemed superior in sanctity to the public weal, and as long as the destructive controversy of "State versus National rights" absorbs all constructive energy of executive circles.

Even though the Federal government has succeeded in withdraw-

ing an enormous tract of land, amounting in some States to over half of the total acreage, from public entry, the mere reservation of resources seems of no use, and may be directly a bar to the development of certain sections of the country, unless it is supplemented by an adequate system of *operation* under State control. But then, again, American experts have little faith in the ability of government even as a legislator. Says Dr. R. W. Raymond of New York: "An overruling providence has saved our State from the results of absurd legislation in this respect by withholding from it, so far as is now known, any considerable deposits of those minerals to which the most archaic, confused, impracticable and absurd provisions of its mining laws would apply."

In view of these facts, I am satisfied to believe that the German system, though not perfect, is in every way superior to the American plan. More beneficent, more scientific, and more practical in a national economic sense, restraining private initiative and cutting the profits of private enterprises, but, on the other hand, distributing the earnings of capital more equitably among the people, the German system is at least definite and clear as to the scope and operation of the law; it is uniform in concentrating disconnected impulses in one direction, and it has in it none of the elements of uncertainty and of dependence on demagogism, which prove so disturbing to the stability and continuity, and last, not least, to the *credit,* of enterprises in the United States.

Of course, it should be acknowledged at once that the success of the German system of administration and operation depends entirely upon the moral and intellectual qualities possessed by the Government. It stands and falls with decent officialdom. If the bureaucracy ever become commercialized and corrupt, if public servants ever place the striving for gain above the striving for honor, then the whole system grows rotten and, perhaps, worse than private monopoly. And here our foreign friends will readily see, in passing, why absolute obedience to the law, speediness in the administration of justice, strict discipline in the country's service, are so essential for us; why we esteem next to the warrior, and in order of public regard rank second only to the administrator, the executor of the law, honoring and elevating high above commercial shrewdness, mechanical ingenuity, and legal talent—which can be bought—righteousness and fidelity and character, which are the pillars of public ownership and operation.

It is a notorious fact often lost sight of by Americans that public enterprise, being easily reached and quickly held to account by public criticism, tends to develop a high-minded and even effective class of public servants, their inferiority in commercial subtlety being counterbalanced by their superiority in administrative morality, which is, after all, a mightier factor in national efficiency than all the other factors combined. Yet while the system of public ownership and control works very well in Germany, all points considered, it is questionable whether—if it could be introduced—it would work well in the United States. In the "Gopher Commonwealth," where mineral resources are exploited on a leasing system under State control, results seem satisfactory, at least in a financial way, the people of Minnesota having had to pay no direct taxes in 1910.

It is obvious, however, that the rapid changes which are being introduced into the economics of the State by the spread of commercialism must gradually introduce such imperfections into present truths as we cannot now foresee. Thus, as a result of the growth of private monopoly power, government is forced to extend its sphere of influence into realms of industrial and commercial activity, which were hitherto left entirely to private initiative. And it is further compelled, if inefficiency and stagnation are to be averted, to provide artificial means of thrift and encouragement, which old-time competition provided naturally.

One of the correctives of private monopoly evils, it was said, consists in extending government control and regulation over all trade, including all the chief commodities, staples, and necessaries of life. In the United States the volume of trade depends mainly on three factors, besides the attitude of the common carriers:—the extent of the country's production of food stuffs and raw textiles, the willingness of Europe to invest capital in American securities, and the ability of the country to import the gold it needs for effecting its exchanges. Hence we expect to see government intervention in the States run chiefly along the lines of financial sanitation. In Germany financial conditions are as sound as they can be in a comparatively poor country. We have everything in the way of a central bank, regulation of the flow of circulation and supervision of industrial capitalization. If anything more it is the amount of production, distribution, and price of commodities which remains to be regulated by the central authority.

The above quoted "Kali law" is the first significant step in this direction. It is the firm utterance of the paternal State making it

clear to private enterprise that Government is going to take charge, as receiver, of any business which is itself incapable of developing or finding forms of organization—be they syndicates, kartells, or trusts—which will satisfy both the social and the economic needs of the Empire. Being one of the few German measures which may serve as a model to American legislators, it will be interesting to learn more of its details. As was said, its purpose is to safeguard the special assets of the nations without resorting to the ultimate means of public ownership and operation. The law provides equal opportunity for all producers, big and small, and equal opportunities to all consumers, domestic and foreign. It assigns, through a supervising bureau, a certain annual quota to each mine, the amount depending upon the producing capacity and output of the mine in previous years. It levies a graduated tax, an internal revenue tax by nature, on excess deliveries, regardless of whether the goods are destined for home consumption or for export. It prevents dumping abroad by providing that part of the quantity of potash allotted to each mine must be reserved for domestic use, our domestic trade in potash being larger than all the foreign trade combined. Finally, it fixes the maximum price at which potash may be sold on the home market, allowing a fair profit to the mine owners and making provisions to the effect that the export price must not be lower than the inland price.

More interesting even that the operations of State partnership and control of industrial enterprises are the effects which it exercises on the general business of the country. Considering that the State is a producer, a legislator, and a consumer at the same time, it is obvious that Government possesses the power to regulate the flow of business, that it can prevent sudden shocks, averting or, at least, softening panics and making for stability and continuity of enterprise. Technically speaking, the State in Germany acts like the governor and flywheel of a mighty engine, cutting off and storing in its mass surplus power in periods of abundance and yielding it again to the machinery of business in times of relaxing activity and rising need.

Stability and continuity of business is a great blessing to the whole community, but especially is it a blessing for the less fortunate working classes of the land, who in times of adversity are the real sufferers. There is no better proof of the fundamental difference between our respective economic systems—the American regulating itself and the German being regulated by a beneficent government—

than a comparison of business fluctuations in certain intervals. The sharp ups and downs from boom periods to depressions in America are but mildly reflected in our mean economic curve. And while we do not know the sensations and gains of wild speculation, we are also spared the calamities and losses which impulsive action entails. Nor do I hesitate to say that there is a marked tendency among conservative statesmen in Germany to avert, by all means, that influx of American tendencies which would transplant the spirit of extravagance, waste and destruction from your "unlimited" to our "limited" opportunities. Germany simply can not afford to run things on the American plan. We can not afford to follow you either in prodigiousness or in prodigality. We could not afford even to be democratic, commercially, if politically we had any leaning in that direction, as long as the experiment is as expensive as it is in the United States.*

The State obviously can succeed in the fulfilment of the noblest of its duties—to be a protector of the poorer classes—only by preserving the German market, which is six times larger and more important than the foreign market, as far as possible from rapid fluctuations and panics, cutting excessive profits on the one hand and making for continuity of employment on the other. Even in the Union, according to a recent interpretation by Justice Holmes, "the State's power to prevent panics must be recognized." And the State can attain this aim, outside of public ownership, only by gaining control over the elements of business—capacity of production, organization of trade, and fixing of prices—in addition regulating wages and working conditions of laborers in such a manner that it will secure for them the best possible benefit of their toil without endangering the competitive strength of our national industries in the world's markets.

State partnership and control, besides steadying business, has the further great advantage that it strengthens the confidence of domestic and foreign investors in commercial enterprise. In these days when the ability to borrow money means everything to a country, enabling industries to continue with the work of construction and reconstruction, keeping mills busy and laborers at work, anything that will restore and maintain the people's confidence in man's work is good. Of course, here again righteousness and ability, and trustworthiness of the country's administration, are the Alpha and Omega

* Compare: Henry Jones Ford, professor of politics in Princeton: "The Cost of Our National Government," a study in political pathology. The Columbia University Press, 1910.

of national credit. Where these faculties are lacking or undermined it is useless to advocate the German system.

Nor does it seem wise in my own country to extend the productivity of the State too far into the activities of a higher order, for instance, to industries where creative ability, elasticity, and agility are decisive factors. These the big body of the State can hardly possess in the same degree as private enterprise, because in public operation the personal element of gain is lacking, and because the sensation of money making can never be wholly replaced by the more exalted feeling of public responsibility, even where ethical values of compensation are so highly appraised as they are in Germany. But it is certain also that, the larger the enterprises of private monopoly grow, the more incrusted, the more fossilized and unwieldly, the more like public enterprises do they become, so that ultimately, the only chance of competition left is competition between State and private activity. For the chances of competition between private industries of the different countries we have seen grow fainter in the measure wherewith enterprise is internationalized, and capitalists find it more profitable to prey jointly upon the world's markets under some form of agreement, than to cut their profits by wasteful competition. International concentration is a natural result of private monopoly, so that the only alternative of stagnation in the different countries is for the State to create thrift and encouragement artificially. But while this scheme of State competition works well in the production of raw materials and, perhaps, half-finished goods, of which the State can produce a reasonable amount, at reasonable cost, it does not do so for the higher grades of goods; because, though the State is a model employer, it is not yet a model manufacturer, nor can be until administrations avail themselves more liberally than heretofore of technical talent.

In this emergency the State comes to the rescue in its function not as a producer, but as a consumer and educator. Its services in this direction are so numerous that at this place it is possible to dwell on only one or two of them in the briefest possible manner. Taking, for example, the Prussian State railways. It is known that they are the greatest consumers of coal and iron and steel and kindred products. Being elevated above party politics, above fashions, and above judicial whimsies, their annual demand is fairly constant, and orders are distributed to the various industries according to a predetermined plan, thus guaranteeing a certain steadiness of industrial activity the year round. In times of depression Government

can, of course, help to adjust conditions by pushing construction. Having eliminated discrimination to shippers, cut out political corruption, lobbying and favoritism, avoided over-capitalization and gambling with railway stock, stopped the waste of divergent effort and overconstruction on speculative values, the nationalization of railways has effected all the economies which the United States are striving to attain through the application of efficiency systems to the various private roads. Being subject to criticism in the Parliament, having to make public account of their activity, the State railways are a mighty weapon in the hands of the people, making for unity of transportation facilities, safety and promptitude of service, stability of enterprise and diffusion of profits. That the State railways are a good, though not stable, source of revenue to the Government (yielding in Prussia 59 per cent of the gross income, of which the fiscal mines contribute 9 per cent), and that, last not least, they are a powerful instrument of strategic usefulness in the hands of our military authorities, goes without saying. But what is even more important for engineers is the fact that, as the biggest of all consumers, our railways are in a position to force industries, by specified orders, to supply not merely what is commercially most profitable to private monopoly, but what is technically best suited for public safety, for industrial service, and for national progress.

Likewise, considering the army and navy—the pillars of our national defense—in the light not of engines of destruction (as the apostles of peace love to do), but of consumers of the products of our home industries, it is easy for the engineer to see what educating and quickening influence these agencies exercise on national productivity. In this leveling age of ours when almost everything makes for mediocrity of endeavor, it is wise to regard the stern art of warfare not merely as a means of demolition, but as an instrument of progress and character building—to regard not only the deplorable loss of life and capital which it involves, but to reflect also upon the beneficent effects which it exercises as a tonic to national industries.

There is a natural identity of aims between the modern State, whose duty it is to protect the country against foreign invasion, and the creative class of men, whose very existence rests on the provision of adequate means of defense. Thus army and navy are both the defenders and stimulators of technical excellence, being of all consumers, private and public, the only ones which act free from mercenary motives, subordinating the price to the quality of goods,

asking not for the cheapest but for the best materials money can buy. Where would our Krupps, our Loewes, our Siemens, where would our high-grade industries have their being, if it were not for the need of tempering the country's armour?

Capitalism, in spite of all the social agonies it creates, is a necessary stepping stone for the uplift of humanity; and so is war the great nation builder. He is, indeed, an evil friend of his people, a poor *connoisseur* of history and human nature, who would replace the sturdy virtue of manliness, the elemental love of country, the cultivation of national ideals, by hypocrisy, internationalism and the vulgar scramble for money. Material rewards never have inspired and never will inspire men to noble deeds, to self-denial and self-sacrifice which are essential to the progress of nations.

Nor does progress often travel along the path of least resistance, whereas character and genius always develop their highest faculties when they are forced to overcome obstacles. Thus American engineers have become masters in the art of over-bridging distance, which is far, and overcoming labor, which is scarce, while German engineers under the stress of necessity excel all others in the art of utilizing scant resources, cutting out waste, reducing losses by efficient organization, and creating novel values of exchange from worthless *débris*. Wherefore we have no premises on which to envy our richer brethren for their imminent plenty, but are satisfied and resolved to make the best of our perennial want, taking consolation from the words of Francis Bacon: "Prosperity was the blessing of the Old Testament; adversity is the blessing of the New. Which carrieth the greater benedictions?"

THE CEMENT AND IRON INDUSTRIES: A COMPARATIVE STUDY.

By Edwin C. Eckel.

The following paper is based, in part, on an address delivered by the writer before the Association of American Portland Cement Manufacturers at their meeting in New York City in December, 1910. That address will be printed elsewhere in its original form. For the present paper, material modifications have been made both in scope and in presentation. The more important of these changes are in the elimination of certain sections which were of interest to cement manufacturers only; in the extension of the comparative method to other phases of the cement and iron industries than those originally published; and in the presentation of additional matter relative to the iron industry itself. The following paper, therefore, covers a much broader field than did the original address; and is, it is hoped, a more balanced presentation of the subject so far as general technical and industrial interests are concerned.

Since the delivery of the original address, the United States Geological Survey has published a preliminary estimate of the Portland cement production for 1910, while final statistics of the iron industry of that year have been published by the American Iron & Steel Association. In the present article these newer figures have been substituted, wherever possible, for less complete data which were used in the address. The two statements of the case will therefore differ somewhat in their figures, but the general conclusions reached are not altered.

SOME years ago, in the course of an official report on the American cement industry, I took occasion to draw comparisons, along certain lines, between the cement and the iron industries. It was pointed out that the two industries agreed in being engaged in the manufacture of products which were bulky and cheap, and that in each case transportation entered heavily into the final cost of the product to the consumer. The present time seems appropriate for a re-examination of these questions, and for an extension of the comparative study then begun. Both industries are emerging from a period of industrial strain, during which the question of profit was not as important as that of mere existence, and both are looking forward to a period of better conditions. No one who was interested in the two industries can have failed to recognize the fact that the period of business depression through which both passed affected them in very unequal manner. It is of interest to attempt to determine why this difference exists, and whether there is any reason to hope that in future the cement industry may acquire the same degree of resisting power as the iron industry.

In working out along this line a comparison of the two industries, the factors to be considered fall naturally into three groups.

In the first place it is necessary to compare the general industrial importance of the two industries, as measured by the tonnages and value of pig-iron and cement annually produced, the capacity of existing plants, and the capital actually employed in the two lines of manufacture. After this it will be possible to compare the two industries with respect to tonnages handled, and to the costs and profits which are yielded on a tonnage basis. Finally, it is profitable to consider the geographic localization which has taken place in both the iron and cement industries and the effects of this localization.

I. The Relative Industrial Importance of the Iron and Cement Industries.

Annual Output.—While the importance of the American iron industry is a matter of popular knowledge, the rapid growth and present standing of our Portland-cement industry is rarely comprehended, even by those directly interested in it. This fact was brought home most forcibly during the preparation of the present paper, when a direct tonnage comparison between the two industries was instituted for the first time. Some half-dozen years ago, when I first compared the annual output of the American iron and cement industries, it was necessary to plot the pig-iron output in tons of 2,240 pounds and the Portland cement output in barrels of 380 pounds, in order to bring the two curves together on the same diagram. The necessity for doing this has passed away with the recent rapid growth of the production of cement, and it is now possible to make our comparisons directly in long tons.

Comparison of the two sets of figures year by year is interesting, but it is hardly necessary to go into so much detail in the present discussion. The following table will suffice to summarize the main features of the past three decades, giving the output of pig-iron and cement during every fifth year from 1880 to 1910 inclusive:

Table 1.—Comparative Growth of Iron and Cement Industries.

Year.	Pig-iron, long tons.	Portland cement, long tons.	Percentage, cement to iron.
1880.....	7,749,233	7,000	0.1
1885.....	7,415,469	25,000	0.3
1890.....	9,202,703	56,000	0.6
1895.....	9,446,308	165,000	1.7
1900.....	13,789,242	1,414,000	10.3
1905.....	22,992,380	5,874,500	24.3
1910.....	27,298,545	12,500,000	47.0

The relative growth of the two industries, as shown in the last column of the above table, is the point of greatest interest. It will

be remembered that the thirty years covered in the table was a period in which the American iron industry was practically reconstructed in order to meet the requirements of modern large-scale production; and that in this period it had impetus given to its growth by the opening of the most productive of the Lake ore-ranges. In spite of these facts, however, the growth of the iron industry did not begin to compare with that of the newer manufacture. These relations are brought out still more strikingly on the diagram, Figure 1. On reference to this it will be seen that although the American iron industry has shown a rather remarkable rate of growth, particularly since 1896, this rate has been more than surpassed by that of the cement industry.

In this connection it is also of interest to note that as yet, even during years of severe business depression, the cement output has never shown a decrease. In the iron industry, on the other hand, such temporary reversals of trend are common, having been particularly noticeable in 1908 and, to a somewhat less extent, in 1904 and 1894. Taking account only of the present condition of the two industries, we can say that the tonnage of Portland cement produced during the past year was almost exactly half that of the pig-iron produced. It is practically certain that during 1911 the cement tonnage will improve on this comparison.

VALUE OF ANNUAL PRODUCT.—When the comparison is extended so as to take account of value of product, however, the disparity between the two industries is considerably increased. Exact figures as to value during 1910 are not of course obtainable, but it will probably not be far from the truth to assume that the pig-iron output averaged in value about $15 per ton, and that the Portland cement produced was sold at an average price of $5 per ton. The total value of the pig-iron produced during 1910 was therefore in the neighborhood of $400,000,000, while the cement output aggregated about $60,000,000 in value. It will be seen later that this great disparity in value is out of all proportion to the capital required in the respective industries

PRODUCTIVE CAPACITY.—There is, of course, always a considerable gap between the actual output in any given year and the total nominal capacity in that year. This is true in both the iron and cement industries. Even in a year when every plant is apparently pushed to the utmost, we find that relining furnaces and kilns, strikes, accidents, etc., make a heavy deduction from the nominal available capacity. Even after allowing for this fact, however, it is to be noted that in 1910 there was more than a normal disparity between

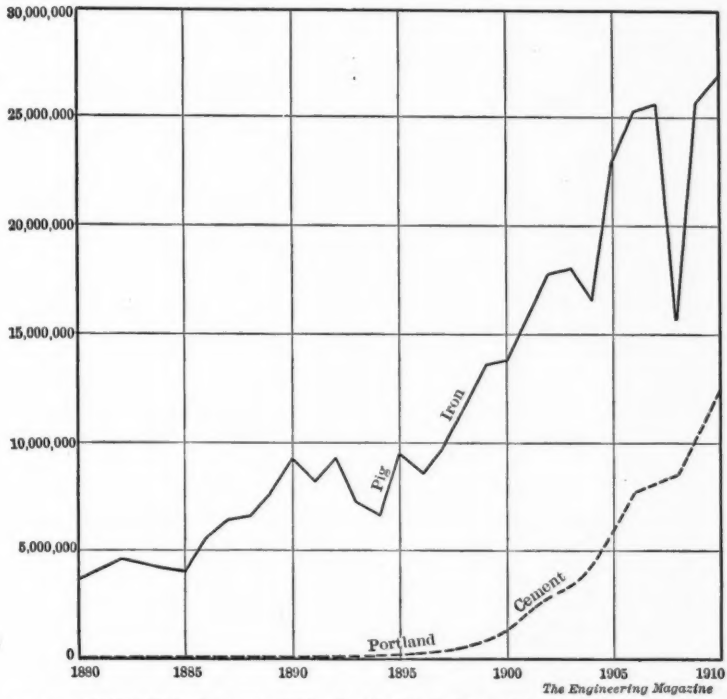


FIG. I. COMPARISON, IN LONG TONS, OF AMERICAN IRON AND CEMENT PRODUCTION.

the actual production and the productive capacity. This was more apparent in the cement than in the iron business, but it occurred in both industries.

It is probably entirely safe to assume that at present the blast furnaces of the United States have an actual available capacity of 35,000,000 tons of pig-iron per annum, and that this tonnage could actually be produced in 1911, for example, if business conditions warranted operations on this scale. As compared with this furnace capacity, the Portland-cement plants of the country will have in 1911 an actual capacity of close to 17,500,000 tons. The cement capacity, like the cement production, is about half that of the iron capacity and production.

CAPITAL EMPLOYED.—The capital actually employed in each of the industries is about the same on a tonnage basis, being closely equivalent to ten dollars of capital per ton of actual annual output. This includes real estate, plant, machinery and working capital. The figures given have, of course, no definite relation to the amount for

which the two industries are "capitalized," which is a very different matter. On the basis of capital actually employed, the pig-iron interests of the United States would represent an actual investment of somewhat over $300,000,000, while the cement industry would represent a little under $150,000,000. When this statement as to capital used is compared with previous figures concerning the value of annual output, it will be seen that the rate of turn-over of capital is markedly different in the two industries, being approximately three times as fast in the iron industry as in the cement business. The effect of this difference on the relative rate of profit in the two industries is painfully obvious, and will be recurred to later.

Relative Standing of the Industries.—It is best to summarize the facts heretofore presented, before going on to another line of comparison between the iron and cement industries. In regard to three of the matters which have been considered—annual output, productive capacity, and capital employed—we find that the cement industry is just about half as important as the iron industry. When value of product is considered, however, iron becomes far more important; and this fact has an important influence on the respective profits of the two industries.

The growth of the Portland-cement industry has not ended, and its present relative importance is rarely understood. Its increase in size and in commercial influence bring with them certain consequences which might well be borne in mind at the present moment. We can no longer feel that the cement industry is small and unimportant, and that its condition is purely a matter of private or local interest. On the contrary, it must be realized that the soundness of the cement industry has now become a matter of interest not only to cement manufacturers, but to commercial and financial interests generally. In capital employed it probably ranks third only to iron and coal among the American mineral industries. It certainly far outranks, in this respect, all the gold-mining industry of the United States and Alaska. Even the copper industry falls into lower place, for Finlay has recently estimated that the value of all the copper-mining and smelting plants of the United States is only $110,000,000. From the banking point of view, therefore, we are dealing with one of the world's three great extractive industries.

II. Comparison of Tonnages, Costs, and Prices.

Passing from general comparisons of the relative importance of the iron and cement industries, it is of interest to compare the raw materials handled, the costs of raw materials and labor, and the prices obtained. This can be done most satisfactorily when the com-

parisons are made on a tonnage basis; and in the present section all the data are therefore referred to the same basis—the long ton of salable product.

TONNAGES HANDLED.—The following table contains data on the quantity of the various raw materials required in the manufacture of one ton of iron or of cement. In the case of pig-iron two sets of figures are given. One of these is based on practice in Alabama, where low-grade ores and rather poor fuels are in use. The other set of iron figures is representative of Pennsylvania practice, where the coke is of high grade, and the ores, whether Lake or foreign, are excellent. The figures for cement manufacture are fairly representative of a plant running on a mixture of limestone and shale. In the case of the cement figures the amount stated for coal includes both kiln and power coal.

TABLE 2.—COMPARISON OF TONNAGES HANDLED IN IRON AND CEMENT INDUSTRIES.

	Alabama pig iron.	Pennsylvania pig iron.	Portland cement.
	2.32 tons ore	1.63 tons ore	1.18 tons limestone
	0.57 tons flux	0.50 tons flux	0.39 tons shale
	1.55 tons coke	1.07 tons coke	0.53 tons coal
Total tons raw materials used.....	4.44 tons	3.20 tons	2.10 tons
Total products made.....	1.00 ton pig iron 1.73 tons slag	1.00 ton pig iron 0.97 tons slag	1.00 ton cement

Inspection of the above table will show that the amount of raw material necessarily handled in the course of making a ton of salable product is considerably larger in the manufacture of pig-iron than in the manufacture of Portland cement. Even in the Pennsylvania region, where ores and fuels are of the best, somewhat over three tons of raw material go to the making of one ton of pig-iron; while in Alabama raw materials of lower grade necessitate the handling of four and a half tons to the ton of pig. In the Portland-cement industry, on the other hand, a little over two tons of raw material suffice to make a ton of cement. Of course, this great disparity between the tonnages handled in the two industries would disappear if the slag produced in the course of iron manufacture could be considered salable product; but even the most profitable utilization of slag leaves it a very unimportant source of revenue to the furnace.

RAW MATERIAL AND LABOR COSTS.—The preceding comparisons become more interesting and important when the element of cost

is considered in connection with that of mere tonnage. Taking the quantities presented in Table 2, Table 3 has been prepared by the use of actual costs per ton for each of the raw materials, and the item of labor per ton of product has been added.

TABLE 3.—COMPARISON OF RAW-MATERIAL AND LABOR COSTS PER TON OF PRODUCT.

Alabama pig-iron.		Pennsylvania pig-iron.		Portland cement.	
Iron ore	$1.90	Iron ore	$5.17	Limestone	$0.39
Flux stone	0.28	Flux stone	0.34	Shale	0.09
Coke	3.65	Coke	2.63	Coal	1.19
Total raw mat'ls	$5.83		$8.14		$1.67
Labor costs	1.15		1.18		0.58
Raw material and labor	$6.98		$9.32		$2.25

It will be understood, of course, that in making up the preceding table only the three most important raw materials, and the bare labor cost, have been considered. Minor raw materials—gypsum, scrap, etc.—have been omitted, as have been repairs, waste, superintendence and all overhead expenses. The figures given for the iron industry represent actual costs during an entire year. It is probable that during 1906 and 1907, when labor was inefficient and supplies dear, iron costs easily exceeded those quoted by 10 to 15 per cent. As to the cement costs quoted, any efficient and well-located plant can match them.

RELATION OF COSTS TO PRICE AND CAPITAL.—Up to this point in the comparison, the great disadvantage under which the Portland-cement industry labors, as compared to the iron trade, has not been so apparent as to require comment; but with the next step in the discussion it becomes obvious enough. It arises primarily from the fact that, of the two industries, the manufacture of cement requires the investment of a disproportionate amount of capital. The effect of this factor on financial results appears in the following table:

TABLE 4.—COSTS, PRICES AND CAPITAL.

	Alabama iron.	Pennsylvania iron.	Cement.
Material and labor per ton	$6.98	$9.32	$2.25
Selling price per ton	11.20	14.98	4.50
Capital employed per ton	9.65	10.75	10.00
Margin between cost and price	4.22	5.66	2.25
Ratio, margin to capital	43.7 per cent	52.7 per cent	22.5 per cent

It will be seen that in the iron industry, during the year to which the data relate, the margin between the cost of raw materials and labor, and the selling price of the product, amounted to an average of 48 per cent on the capital employed. This margin had to cover

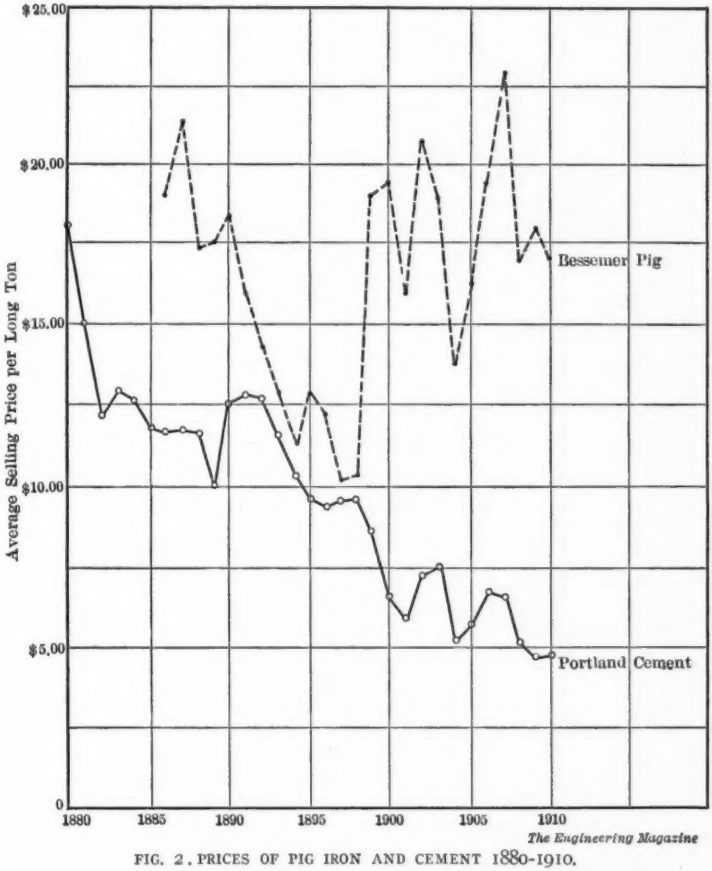


FIG. 2. PRICES OF PIG IRON AND CEMENT 1880-1910.

all the other items of costs, as well as depreciation, fixed charges and profits. In the cement industry the corresponding margin was only 22½ per cent, and it can readily be understood that under such conditions very little of it remained for profits after subtracting the other mill and overhead costs and charges.

THE TENDENCY OF PRICES.—An interesting difference in the price-history of the two industries is well brought out in the accompanying diagram—Figure 2—on which the average prices of cement and pig-iron have been plotted. The curves cover the period 1880-1910, so that the temporary price-fluctuations due to general business conditions can be separated from broader movements due to changes within the trades themselves.

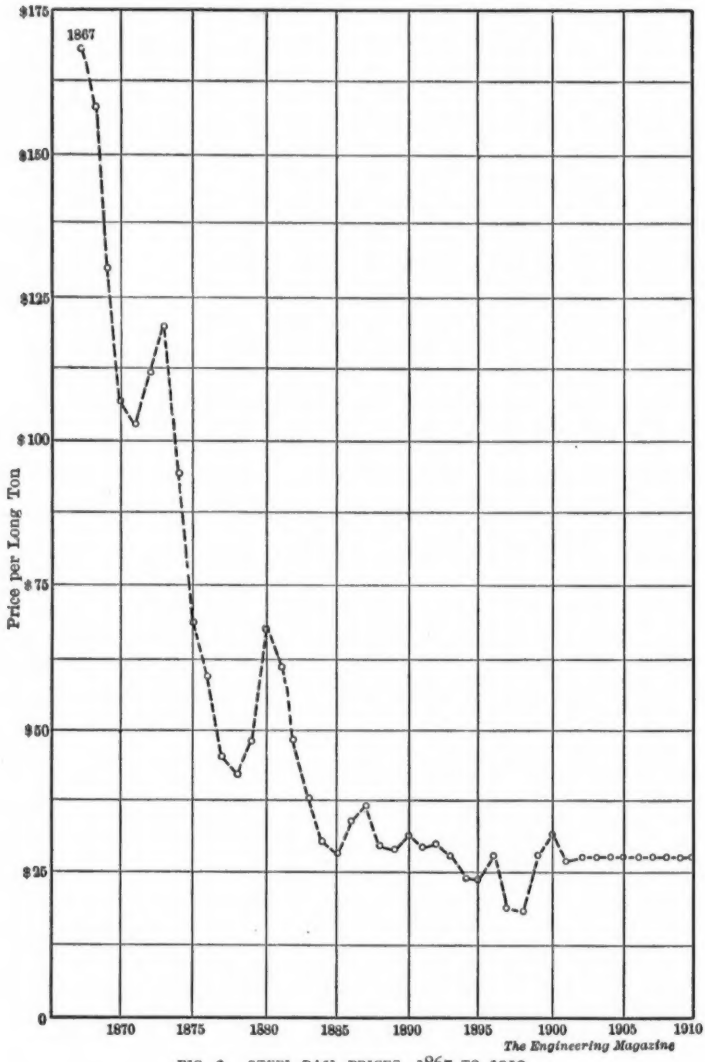


FIG. 3. STEEL RAIL PRICES, 1867 TO 1910.

On examining this diagram it will be seen that during the early history of the American Portland-cement industry there were several long periods when cement sold for about as much per ton as Bessemer pig. This seems almost incredible, in view of the present relation

between the prices of the two products, for in the past ten years pig-iron has been steadily worth from three to four times as much per ton as Portland cement.

The marked divergence between the prices of iron and cement began in 1898, when cement prices failed to follow iron prices upward during the boom then commencing in general business. On the contrary, cement prices fell markedly and almost continuously until the present day. In all our industrial history there is nothing to compare with this downward movement except the spectacular decline in steel-rail prices during the four decades 1867-1897. In order to make this comparison available, Figure 3 has been prepared to give the rail prices for the period in question. It shows very strikingly the sharp decline from over $166 per ton in 1867 to $18 per ton in 1897, and also illustrates the early ineffectual attempts to steady prices around $28, and the later success of this effort.

THE TENDENCY OF COSTS.—Several years ago, in a little volume discussing the financial side of the Portland-cement industry, the writer took the ground that further marked reductions in the cost of cement manufacture could hardly be expected; and as yet there seems to be no reason to change position on this point. It would seem that a standard Portland-cement, manufactured in the usual way under normal conditions as to raw material, power and fuel, cannot well be produced at a much lower mill cost than the best of the existing plants have shown during the past three or four years. Local conditions may, of course, give exceptional low mill costs in exceptional localities —but it would be better if the fortunate plants which have exceptionally cheap power or fuel would regard their gain in this respect as an addition to their profits, and not as a reduction in their costs.

There is, of course, to be considered the possibility that the cement industry of the future may not be an independent industry, but rather an incidental attachment to the iron and alkali industries. Recent developments have by some been considered as pointing in this direction. The result on costs, in at least one of these cases, would be little short of revolutionary. But until this tendency is much more clearly defined, it will not be taken account of by the cement manufacturer.

As to the iron industry, the tendency of costs is distinctly upward, and it is highly improbable that even a prolonged business depression would enable any furnace to show such low costs as were attained during the depression of the nineties. The lowering grade of our iron ores, the steadily rising wage, and the higher range in coke prices, all tend toward higher costs for pig-iron.

III. Localization and Consumption in the Iron and Cement Industries.

In the present section attention will be directed to the manner in which the two industries are localized geographically, and also to the effect which this localization has had on the consumption of iron and cement in different areas.

Present Localization of the Industries.—For convenience in this discussion the States have been divided into six groups. This grouping is, to some extest, rather arbitrary, but regard has been paid to trade conditions as much as possible. The six groups in question are termed "Northeast," "Middle West," "Southeast," "Southwest," "Rocky Mountain and Plains," and "Pacific Coast." The first group includes the States of New England, together with New York, New Jersey, and Pennsylvania. The Middle West, as the term is here used, includes the remaining States north of the Ohio together with the first tier of States on the west of the Mississippi. Southeast includes the States east of the Mississippi from Kentucky and Maryland southward. The Southwest, because of trade conditions, is made to include only the States of Kansas, Oklahoma, Louisiana, and Texas. With the Pacific Coast States in a separate class, the remaining western States are grouped in the Rocky Mountains and Plains.

With this explanation as to the manner in which the groups are made up, we are prepared to take up the present localization of the two industries. This has been done in the following table, in which the cement production of 1909 and the pig-iron production of 1907 are divided according to location:

Table 5. Localization of Iron and Cement Production.

Area.	Cement 1909.	Iron 1907.
Northeast	43.3 per cent	51.9 per cent
Middle	32.3 per cent	32.8 per cent
Southeast	4.4 per cent	13.4 per cent
Southwest	10.9 per cent	0.05 per cent
Rocky Mountain	2.7 per cent	1.8 per cent
Pacific	6.4 per cent	0.05 per cent

In explanation of the dates selected for the above comparison it may be noted that the pig-iron production for 1907 was used in preference to that of 1909 or 1910 because the output of 1907 seemed to show a more normal distribution of activity in the several regions than has been noticeable since that year ended.

In comparing the two industries, as in Table 5, it will be seen that in the Northeast, the Middle States, and the Rocky Mountain States the two industries are on a fairly comparable basis so far as per-

centage of the total output is concerned. They differ widely, however, in the Southeast, where the iron deposits of Alabama have caused the iron industry to give a relatively high production; in the Southwest where natural gas and favorable west-bound freight rates gave a corresponding advantage to the cement industry; and in the Pacific States where the cement industry has developed far beyond the iron industry.

LOCALIZATION OF CEMENT PRODUCTION.—Taking up the cement industry separately, the manner in which its output was distributed in 1900 and 1909 is shown in the following table:

TABLE 6. LOCALIZATION OF CEMENT PRODUCTION, 1900-1909.

Area.	Production 1900. Barrels.	Production 1909. Barrels.
Northeast	6,619,461	27,081,495
Middle West	1,469,407	20,163,186
Southeast	98,479	2,764,287
Southwest	106,000	6,818,516
Plains and Rocky Mountains	106,108	1,663,054
Pacific Coast	44,565	4,017,923
Total output	8,482,020	62,508,461

This comparison at the two dates in question shows the manner in which the cement industry has developed recently in certain regions where there was practically no development ten years ago. This development, as seems natural enough, was heaviest in the Middle West. The Southwest, owing to causes which have previously been referred to, also showed a very large increase in actual number of barrels produced and a still greater proportionate increase. The Pacific Coast also shows a heavy increase. The three remaining divisions, however, though of course they show a greater production in 1909 than in 1900, have fallen far behind the others in rate of increase.

PRODUCTION OF CEMENT PER CAPITA, 1900-1910.—It is only when the figures previously presented, as to production in various regions, are compared on a basis of the population of those districts, that we arrive at serious results in this study. This has been done in the following table, which shows the per capita production of cement in the various districts in the years 1900, 1909, and 1910. The production for 1900 is compared with the population for the same year. The production of 1909, the last for which we have detailed statistics available, is compared with the results of the recent Census. In taking up the estimated figures for 1910, the production for 1909 has been increased approximately 10 per cent throughout, while the comparison is with the same statistics of population:

TABLE 7. PORTLAND CEMENT PRODUCTION—POUNDS PER CAPITA, 1900-10.

Area.	1900.	1909.	1910.
Northeast	119	398	437
Middle West	19	296	325
Southeast	2	44	49
Southwest	7	358	394
Plains and Rocky Mountains	12	126	138
Pacific Coast	7	368	405
Average, United States	43	257	283

Examination of this table shows, to begin with, that the production of cement per capita in the entire United States is now in excess of the German cement production per capita. In view of the fact that Germany is confessedly a cement-exporting nation, this comparison is itself of considerable commercial interest. But the matter becomes more impressive when we examine the statistics for the different districts separately. Assuming that the production of 325 pounds per capita in the Middle West represents about what can be absorbed under normal conditions, we see that the Northeast, the Southwest, and the Pacific Coast have a per capita production considerably in excess of this; while the Plains States and the Southeast have a very small output per capita. As regards the Southwest the siuation is qualified when we remember that, by taking advantage of cheap fuel supply and low westbound freight rates, that district has been able to ship a disproportionate share of its output into the Plains and Rocky Mounain States. This fact accounts in part for the low per capita production in the Plains States.

The small production in the Southeast is due largely to the manner in which this district has for many years past been a dumping ground for the excess product of the Northeastern mills. A splendid natural market for cement has been largely destroyed in this process, and it would take a number of years of careful handling to bring the southern market back on a reasonable basis.

With regard to conditions in the Northeast, I think everyone will agree that the 437 pounds of cement produced per capita during 1910 is more than the market will stand under ordinary conditions, and that if the total capacity in this district were ever in operaion at once the result would be disastrous. There seem to be two possible ways out of the difficulty into which the Northeastern mills have plunged themselves, in order to avoid entire demoralization of this market during periods of dull or declining business.

DIRECT SELLING AND THE EXPORT TRADE.—The two methods of handling an over-built district, alluded to here, will appeal with dif-

ferent force to different men. The one way would be to adopt the policy of going actively after the small consumer, and making strenuous efforts to teach everybody to use cement for all possible purposes. This might involve in the end the partial or complete elimination of the middle-man, and the adoption of a policy of selling direct from warehouses to relatively small consumers. In the West more has already been done in this line than in the Eastern States.

The second method of saving the home market is to prepare for an active export trade. At present both the iron and cement industries export from 3 to 5 per cent of their total ouput.

Of course, in one sense, such a comparison of exports bears too hard upon the iron industry, for while the tonnage of cement exported above quoted comprises practically all of the cement and cement products shipped from this country, the bulk of our iron and steel exports are really in the more profitable forms of machinery, implements, etc.—and these finished products are not included in the figures above quoted.

If an attempt to secure a large export trade were directed with half the selling ability now used in the home market, it is certain that the Northeastern cement mills would be able to dispose of a very important portion of their product in West Indian and South American ports. It would not, of course, be a very profitable business of itself, but it would enable the manufacturers to maintain reasonable prices in the home market.

From a broad point of view it is of course true that no great profit to the country can be expected from an export trade in such relatively low-grade products as cement, pig-iron, and the comparatively unfinished forms of steel and iron. From the standpoint of maintenance, both of prices and of stable business conditions, however, an export trade may be advantageous to an industry even when it is normally unprofitable of itself. The critical writer in the popular magazines worries a great deal over the dumping of our products at low prices in foreign countries, but the same critic would have cause to worry a great deal more if he were responsible for the disposal of the surplus product which modern industry always causes to accumulate rapidly in time of local trade depression. However the law and the muck-raker may look upon it, our only solutions to the problem of over-production are dumping or most rigid restriction of output; and of the two solutions the latter does not demand consideration in the present discussion.

A SIMPLE SYSTEM FOR JOBBING AND REPAIR SHOPS.

By W. O. Horsnaill.

The system herein outlined is not offered as a new creation, but as an adaptation of proved methods and an application of sound principles to the conditions and circumstances of a small establishment. While it refers primarily to British conditions, the elements are fundamental and hold true anywhere.—THE EDITORS.

MANY small engineering shops, dotted about the country, depend mainly upon jobbing and repair work for a living. The majority of these concerns are old-fashioned in every sense of the term, the principles, foremen, workmen, methods, and equipment being entirely out of date when compared with a modern machine shop. The standardisation and systematic manufacture of machinery—which has now become almost universal—tends to benefit these jobbing and repair shops, as such work cannot be profitably carried on in conjunction with the systematic production of standard machines or appliances. On the other hand, competition has seriously affected the prices obtainable of odd work, and estimates from several firms are now demanded where open orders were given out a few years ago. Furthermore, the correct estimation of such work demands good judgment, as figures for previous jobs of a similar character are seldom available in a usable form, hence prices are to some extent guessed at and often are hopelessly wide of the mark. This contention is amply supported by the estimates sent in for comparatively simple jobs, the highest being generally double the lowest, whilst the latter is not unfrequently below cost price when standing charges have been adequately allowed for. The effect of such estimating is naturally to lower prices for everyone concerned, and it is generally traceable to lack of system in connection with the accounts of the lowest tenderer.

Everyone admits the need for systematic methods up to a certain point, but great difference of opinion exists as to where "system develops into red tape." Similarly, certain general rules are readily acknowledged; it is only the means of carrying them out which are open to discussion.

These general rules may be set forth as follows:

1—The time spent and the material used upon each job must be correctly recorded.

2—The correct proportion of the indirect expenditure on rent, power, offices, etc., should be allowed for in the account.

3—The most efficient tools and equipment must be used.

4—The workmen must be caused to put forth their best efforts for the greatest possible proportion of their working hours.

5—The designs of the work undertaken must be: firstly, effective; secondly, economical as regards labour and material.

6—Tools and material must be so kept and checked as to be quickly available, whilst pilfering is rendered almost impossible.

Every proprietor of a small engineering works will endorse the above principles, but when the only effective means of carrying them out are propounded to him, he is apt to condemn them as a waste of time and paper. This attitude has been engendered partly by attempts in the past to apply to small concerns the methods necessary in a large undertaking, which for small shops are unnecessarily cumbersome.

"System" must be introduced into a small jobbing and repair shop with a great deal of care and tact, as unless the co-operation of the foreman and workmen be secured, success cannot be expected. In these small shops, one often finds middle-aged or old workmen who have been there for a great number of years and who consequently know their work well. Such men will strongly resent the introduction of new methods for checking time and giving instructions, and even the fear of dismissal will not always ensure their loyal co-operation in connection with what are deemed irksome features. The wholesale discharge of these old servants in favour of younger men who have been trained under modern systems would be a great injustice if any effective methods can be introduced which will avoid so drastic a measure. The foreman may also be a man of similar type who has never been called upon to perform his duties in a systematic manner. He probably depends upon a good memory for almost everything, aided perhaps, by a private note book. In addition to certain notes relating to orders in hand, these note books often contain a great deal of special information in connection with the work, the whole having been compiled in the firm's time. Such being the case, a foreman's note book might reasonably be deemed the property of the principal, yet a demand that it be given up when full, or even that it be inspected, would be strongly opposed.

So long as the business is conducted by the man who started it and who presumably is conversant with the work, no difficulties arise from this system; but when the principal dies or retires, his son, or an outsider who takes over the concern, finds himself dependent upon

the foreman for any special knowledge connected with the work or the customer's requirements. These conditions will hardly be regarded as satisfactory by the most bitter opponent of systematic methods. By all means keep old and tried servants as long as possible. They understand the work and therefore should be able to handle it quickly, but no one wants to be *dependent* upon them.

It cannot be denied that very good results are often achieved in many small jobbing and repair shops by a hard-working foreman with a retentive memory, but even greater efficiency should follow the introduction of systematic records and instructions without the drawback alluded to above. Even one man working alone cannot depend entirely upon his memory, or if he does, his charges are likely to be erratic. Such a man will have perhaps a dozen jobs in hand at once, unfinished work being often put aside in favour of an urgent repair. Under these conditions, unless the time and material are jotted down as the work proceeds, errors are certain to creep in. Then again, some allowance must be made for rent, upkeep of tools, lighting, fuel, stores, etc., and accounts must be kept in some simple form to enable a correct allowance to be made for these items as a percentage on the time or labour cost.

Neither can the one man working alone afford to ignore our general rules 3, 4 and 5. He must obviously have the best tools, and the latter as well as material must be so kept that they are available at once without wasting time looking for them. Where half a dozen to twenty workmen are employed, these features become of much greater importance, and the methods adopted will have a vast influence upon the results.

Whatever system be adopted for carrying out our general rules, some means of distinguishing the orders, apart from the customers' names, must be employed. Furthermore, it is not advisable to pass on the actual letters to the foreman, hence the particulars should be copied onto another sheet for this purpose. It is also useful to retain a copy of these instructions in the office as the originals may occasionally be lost or destroyed. This can be done by using a manifold book, with or without printed headings, according to the number dealt with. These manifold sheets should be numbered consecutively, thus forming the order numbers referred to later.

Eacn of the general rules will now be considered separately.

1—The Correct Recording of Time and Material for Each Job.

This is the most difficult problem we have to deal with in the type of shop and with the description of workmen under consideration. A

usual plan is for each man to record his own time on a chalked board, these boards being collected once a day or even once a week, for entry into the time book. Anyone who has seen the old-fashioned workman making out one of these boards will require little further evidence of the disadvantages attached to this system, the waste of time being a sufficient condemnation alone. A description of the process is somewhat as follows: first, the old marks have to be obliterated by rubbing on fresh chalk, the latter being often borrowed of a mate in conjunction with a little chat; second, lines are ruled for columns and headings, entailing a further converse over the loan of a pencil; third, the order numbers are generally forgotten, application being made to a mate or perhaps the foreman, who may have to be looked for; fourth, the time being put down from memory is often grossly inaccurate; fifth, the results are indistinct, easily obliterated and cannot be kept as a permanent record, whilst they are difficult to enter quickly in the time book owing to their lack of symmetry. The whole process may take half an hour in extreme cases and apparently has no redeeming feature. If the system must be employed, the cost of printed cards with rulings and headings would be far more than counterbalanced by the saving in time, but we still have inaccuracy to contend with and this cannot be avoided so long as the men are allowed to make their own records. Then again, incorrect times are not infrequently recorded for the purpose of increasing a piece-work bonus or avoiding blame for slowness.

It may be argued that a smart foreman should be able to check such practices, but it must be remembered that jobbing and repair work involves a good deal of discussion between the customers and the principal, and between the latter and the foreman, much of whose attention is thus occupied. Naturally, as the jobs are given out by the foreman, he can check the times by noting them down, and this plan is the ony satisfactory one. Assuming the time to be recorded in this way, the time boards become superfluous and it is only a question of providing the most convenient alternative. This brings us to the now well-known "job card," which is headed for the order number, workman's name (or number), and a description of the job, columns being ruled below for entering the times of starting and completion. When a job is given out, a job card is handed to the workman with the time marked in, and upon completion the card is returned and the time again recorded by the foreman. The only drawback to this method is a lack of flexibility for dealing with breakdown or other urgent jobs. It is no uncommon occurrence for a workman to suspend work on one job in favour of urgent repairs. In

such cases he must give up his job card for a new one, the old card being restored to him when the old job is resumed. Entries of the time when given out or given up must of course be made in each case. The old-fashioned foreman is apt to give trouble over this exchange of cards, and even with the utmost tact it may be necessary to replace him with a younger and more up-to-date man.

Although the system is a trifle rigid when applied to jobbing and repair work, it acts as a check upon the frequent changing of the workmen to new jobs before the old ones are completed, by giving extra trouble to the foreman. This is a good feature, as an interruption to a job always means a waste of time and should be avoided excepting in cases of extreme urgency.

The times may be stamped on the cards by a recording clock, which can also be used to check the mens' time in and out of the works. In fact, this plan is much the best as it saves any possibility of dispute. In any case, the figures should be marked on in ink. This method of taking the time on the various jobs must give correct results so long as the loyal co-operation of the foreman is secured, whilst the cards are subsequently available as a permanent record. Material can be entered on the backs of the job cards, headings and rulings being arranged for this purpose. Whether the foreman gives out material or not, he must certainly authorize it by entering it on the cards. In the ordinary course the jobs will be laid out ready for the men by the foreman, together with the necessary material. It need hardly be stated that these material entries must be made in ink and the cards should have a surface which will at once show any attempt at erasure.

2—The Correct Apportioning of Indirect Charges.

To obtain the total amount spent on these items during six or twelve months is a simple matter, as all expenses can be charged up to one order number reserved for this purpose. With only half a dozen men this plan should prove satisfactory, as the number of items will not be very large and they can easily be abstracted under different headings at the end of each financial period. If twenty workmen are employed, it may be more convenient to institute several standing-order numbers so as to obtain classified results without the labour of abstraction; in either case the principle is the same.

Having found the total amount spent in this way, it is necessary to decide how it should be charged up to the customers.

This question will be more easily understood if we consider it by means of a simple example. We will suppose therefore, that the cost

of items which cannot directly be charged to customers during twelve months has totalled £500 and that the value of the work done comes to £1,200 during the same period. Of this £1,200 we will suppose £200 to be net profit, leaving £1,000 for labour, material and indirect charges. The latter is already fixed at £500, hence the balance of £500 has been spent on labour and material.

The simplest plan would be to add 100 per cent to the labour and material for indirect expenses, but this method is obviously incorrect as certain orders may consist almost entirely of material, and a customer who ordered a steam gauge, with a short length of piping involving perhaps half an hour's labour, would be charged somewhere about 45 per cent extra on the instrument, in addition to 20 per cent profit. From this extreme example it would appear that the indirect charge should be based upon the cost of labour, and this is the plan generally adopted in small concerns. We will suppose that £400 has been spent upon labour, leaving £100 for material, then our £500 for rent, power, office, etc., would appear as 120 per cent on the labour.

This method is not by any means accurate as it takes no account of the use of machine tools. A jobbing shop such as the one we are considering will certainly contain at least one lathe of considerable size, and this tool will occupy much floor space and demand considerable power, hence it should pay its share of these items. Then again, depreciation should be allowed for on its original cost, and a certain charge be made for upkeep, repairs, stores, etc. If these items are reckoned up, it will be found that the cost of running such a lathe may reach 2 shillings an hour, in addition to the man's time, yet under the percentage-on-labour method, a much lower rate will be charged. In a large undertaking where plenty of clerical assistance is available, this drawback is often provided for in the form of a machine rate or of different percentages for the various departments. These methods would be too complex for the small concerns under consideration in which simplicity is essential. At the same time, some allowance should be made for the use of machine tools, and the best way of doing this is to fix a machine rate for each tool, based upon the factors already indicated, and for the foreman to go through each job card and make the necessary additions. This operation is simple enough to a man who understands the work and the results are fairly accurate.

Of course, in computing the total indirect charges included in the percentage on labour, the items going to make up the machine rate must be deducted. Thus a proportion of the rent—according to the space occupied by machine tools—most of the power, together

with an allowance for repairs, capital charges, etc., will be subtracted from the total before the percentage is decided upon. The number of hours worked by each machine per annum will considerably affect its rate and it will be necessary to settle this point. It is obvious that no machine can work during full working hours, as frequent stoppages to set up new work are inevitable. Moreover, in a jobbing shop, it is doubtful whether any machine tool will be kept nominally working all the time, and it is quite certain that drills or shapers will be used intermittently only, perhaps up to 25 per cent of the full working hours. The question must be settled in each case in view of local conditions, and even then may have to be modified when the total charged by machine rates is compared with the deductions from the indirect charges.

Another point which affects both the percentage on labour and the machine rates is the amount of work dealt with during the six or twelve months, upon which the figures are based. If orders are scarce, the indirect charges will be larger in proportion to the labour than when the shop is busy. But it would never do to base our percentage and machine rates on such conditions, as this would increase prices when business is slack and orders are wanted. It is important, therefore, to take an average period or to make due allowance for the amount of work handled.

3—The Need for Efficient Tools and Equipment.

When considering this rule, it must be remembered that a tool which will have a high efficiency in a large manufacturing concern may not be worth the outlay in a jobbing shop. Automatic and semi-automatic tools are seldom needed for repairs and odd work, neither is it necessary to keep a set of limit gauges; but lathes, drills, shapers, etc., should be good solid machines of their kind and kept in good order. Also hand tools require careful attention. It is a mistake to try and economise by using files, taps, etc., in bad condition, as the saving is more than counterbalanced by the cost of extra labour.

It is by no means certain that the use of high-speed steel can be justified for the work we are considering. This steel is very costly, and the machines, if old, are unlikely to be sufficiently rigid to allow of the full benefit being realised. Moreover, many of the men will not have had any experience with the new material. All these conditions are, however, changing in favour of high-speed steel, which is becoming cheaper, whilst old machines are being scrapped and the old-time workmen are falling out in favour of younger men. The question of using this steel is largely influenced by local conditions, but it

is sufficiently promising to warrant a trial before coming to a decision.

Included under this heading is the source of power, the method of transmission, and the layout of the shop. The choice as regards power rests between town gas, oil, and electricity from a public supply main. Steam is quite out of the running for small powers and the cost of replacing a steam engine and boiler by a gas or oil engine may be recouped in twelve months by the reduced expenditure on fuel and attendance, whilst the space taken up by the boiler and coal store will be available for other purposes. Under average British conditions no great difference in cost will be found between gas, oil, and electricity, hence it seldom pays to turn out one of these in favour of another, unless extensions entail the provision of more power. Should it be necessary, however, to make a choice the relative costs can be based upon a consumption of gas of 20 to 24 feet per B.h.p. hour, against .75 pints of paraffin and roughly one unit of electricity. Other costs such as attendance, repairs, stores and capital charges will not differ to any great extent.

The time will assuredly come when every machine tool will be sold with an electric motor embodied in its construction. In the meantime, shafting is the best solution, at any rate where it already exists, but it is important to reduce friction by laying out the shafting to the best advantage. Undue friction may arise from faulty alignment, old-fashioned bearings, or unsuitable belt drives. The alignment should be tested once every twelve months, crossed belts should be eliminated where possible, and thin belts with easy running butt joints should be used. Old-fashioned plain bearings lubricated with grease cause a great deal of friction and they should be replaced by self-oiling or roller bearings. The latter are no doubt costly but they save oil, attendance, and power to such a degree that the expense is fully justified. One effect of saving power in a new plant is sometimes overlooked; this is the reduction allowable in the size of the engine or motor, thus involving lower capital charges. Then again, pulleys, belts, and the shafts themselves may all be reduced in size, the cost being still further lessened. These factors are so effective in a new undertaking that the extra cost of roller bearings is more than counterbalanced, hence the total outlay becomes actually lower.

The layout of a jobbing and repair shop has an important effect upon its efficiency. Light, heat in winter, and ventilation are now well understood factors affecting the output. No man will do his best in a dark, cold or stuffy shop and under modern competitive conditions any falling off in output is serious. Good flooring is

essential and all authorities are now agreed that wood is preferable to any other surface. Brick or concrete is too hard, and where it has been adopted the workmen generally insist on having wood racks to stand on. The floor must be even, and with a surface which is easily kept clean. The machines should have space round them for laying out finished or prospective work, and the operators' positions must be well clear of gangways. A great deal of time may be wasted if a man working a machine has to move frequently for the purpose of letting others pass.

In a small jobbing shop, the distances are generally so small that the "handling" problem is not so serious as in a large concern, at the same time the arrangements should reduce the amount of carrying as much as possible.

4—THE KEEPING-UP OF THE WORKMEN'S OUTPUT.

The considerations bearing upon the effective carrying out of this rule may be classified under two headings: "Facilities" and "Remuneration."

"Facilities" include instructions and the provision of tools and material, also the general tidiness of the shop. The lamentable waste of time where facilities are not systematically arranged, will be best shown by an example. Supposing a turner to have just completed a job, the acquirement of another with tools and instructions will be carried out somewhat as follows:

	Time Wasted
Finding foreman and waiting while he finishes talking to some one else	10 minutes
Finding labourer to assist and getting material to lathe	10 minutes
Obtaining drawing or sketch	5 minutes
Applying to foreman for gauges	5 minutes
Grinding tools	10 minutes
Obtaining lubricant for tool	5 minutes
Finding foreman and discussing meaning of drawing which is insufficiently dimensioned	10 minutes
Total	55 minutes

This is no fancy picture, but describes the kind of procedure taking place every day in many small engineering works. Moreover, the times specified would more often be under than over the mark. Hence we shall be justified in assuming an hour wasted on one job. This loss of time through lack of system extends in an equal degree to the men engaged upon hand work; in fact, it goes right through the whole concern. If we assume only ten men to be employed, each wasting time on only one job a day at a similar rate, and with an average pay of 8 pence an hour, the sum total per annum for 300 days will be £100—a very big item in such a small concern.

But the trouble does not end at this point; we have inefficient tools to contend with, as each man will have his own ideas as to their form. If the best cutting and feeding speeds are to be realised, the tools must be correctly formed by a trained man. Then again, tools require dressing and hardening in the smithy, and if each workman is allowed to hand his tool direct to the smith, chats will be indulged in and further waste of time involved.

It is not possible to eliminate the waste of time entirely, but a few simple rules of procedure will save most of the minutes which are lost in the manner indicated above.

Each workman should be able to go straight ahead with the next job as soon as the last is finished; and to allow of this, the work must be laid out ready by the foreman, with the necessary tools, gauges and instructions. The latter should be written in the form of sketches, drawings, or notes, and in all cases a copy must be kept. Drawings—which are now generally on tracing paper or linen—can be blue-printed, whilst manifold sheets are used for notes or sketches. Necessary writing of instructions includes only dimensions and any important features. Many cases will arise in which verbal explanations by the foreman may be necessary together with instructions regarding the method of procedure.

Drawings will probably reach the foreman with the order forms already referred to, but he must look through them and make sure that they give all necessary particulars before passing them on to the workmen. A great deal of time may be wasted if a drawing fails to show some important dimensions, and possibly the job will have to be temporarily set aside, involving taking it out of a machine and re-setting, owing to the delay in getting the necessary information through the post. In a small shop it will generally be safe to lay out the next job with the tools alongside each man, but of course he will not be given his job card until he has returned the previous one.

To eliminate waste of time between jobs, the foreman (or some one who can act as his deputy) must be handy at all times to note the time on the cards and to give out the new ones. This is a question of office arrangement. A clerk will be needed for bookkeeping, taking the men's time, etc., and if he can be accommodated in an office opening into the shop, he will be able to assist in this work.

In all cases one experienced man should be responsible for preparing all tools. It does not necessarily follow that the tool man will do nothing else; in a very small shop, he may do fitting work as well. He will also prepare any special gauges needed. There are many adjustable gauges now on the market which are very suitable for

small concerns, but the adjustment must be made by an expert, and the tool man will be able to perform this duty. With the jobs, tools and instructions prepared beforehand in the manner indicated, there should be little excuse for delays either between jobs or whilst they are in progress. Furthermore, the foreman's time, although taken up by this work, will not be wasted by disputes over mistakes or discussions on how the work should be done.

5—The Efficiency of the Designs.

There are two or more ways of doing many of the jobs in connection with repairs and odd work, and it is exceedingly important to hit upon the *best* way, having due regard to effectiveness and economy. Very simple jobs, which can only be done in one way, can be passed on direct to a workman; but if there is any choice, some one with the requisite experience must decide on the best course and his decision should be written down on one of the manifold sheets already alluded to. This work may be done by the principal, the foreman, or a draughtsman, according to the conditions under which the shop is managed. In any case, it is unsafe to leave the decision in the hands of a workman. The latter may, however, be consulted; in fact, in all such matters two heads are better than one and an experienced workman can often give valuable advice. More complex jobs, requiring working drawings, will sometimes be received, and if there are many such, a permanent draughtsman may be needed.

It is exceedingly difficult to get a draughtsman who can do this class of work satisfactorily. If a really good man is obtained, his salary becomes a serious item, whilst a draughtsman without a wide experience will cost a lot of money by introducing expensive designs. The available tools must be carefully considered and the foreman should be freely consulted on the way the work is to be done and the material to be ordered. Then again, theoretical knowledge will often be required. If the principal be an experienced engineer with a sufficient knowledge of theory, he will be able to supervise a junior draughtsman, and this arrangement is the best and cheapest. On the other hand should the principal's knowledge be insufficient, it may be necessary to engage an experienced draughtsman. In either case, the latter must have plenty of tact, otherwise friction will arise with the foreman and the designs will suffer from the lack of his advice.

In a small undertaking, if a draughtsman is employed, he should be capable of notifying the principal of any material required. He may indeed write out the orders ready for signing.

6—The Keeping of Tools and Material.

A tool man has already been alluded to, and the question arises as to whether he should take charge of all tools and give them out, or simply make and repair them, the tools being directly in charge of the foreman. The choice beween these methods depends mainly upon the number of men employed. For a small number the foreman should certainly have the tools under his direct control, but in a shop where fifteen to twenty men are engaged the foreman's time will be taken up with other duties, and the care of and giving out of tools should be relegated to the tool man, the latter being accommodated in an enclosure where he can attend to the demand for tools over a half door. No check system will be needed for so small a number of men, as a tool man with an average memory will remember who the more valuable tools have been served out to, whilst lathe tools, chisels, etc., need only be given out in return for old ones which require dressing.

A lock-up enclosure for the storage of valuable material is essential in the smallest jobbing shop, and this store will also be useful to the foreman for laying out small jobs waiting to be done, and also for their reception when completed. It is absolutely necessary that all materials taken out of store should be booked to either a customer's order or a standing order, and whoever looks after the store must be responsible for doing this. Then when stock is taken, the deliveries together with stock in hand at the beginning of a financial period should equal the withdrawals *plus* the material in store at the end of the time. An exact balance is never actually arrived at, as there is certain to be some wastage, but if any great discrepancy is disclosed, pilfering may be suspected and an investigation can be made.

In a very small concern, the foreman will serve out material from the store as he gives out the jobs. In a larger undertaking the clerk already alluded to can look after the stores in addition to his other duties.

Whatever material is kept in stock must be stored in separate bins so as to be quickly found, and care must be taken that the stock is not exhausted in any line for which there is a frequent demand. The want of a dozen washers for some otherwise completed job may lead to waste of time by the workmen engaged upon it, and to the annoyance of the customer owing to the delay whilst these washers are procured. In large engineering works complex systems are in vogue for avoiding any difficulty of this nature, but for small stores such as we are considering, the man who serves out the material should be

capable of keeping up the stock without mechanical aids. It will, however, be advisable to mark each bin with the minimum stock below which a further quantity should be ordered. Iron and steel bars are best kept by the smith, who will deliver through stores, whether pieces of bar or forgings—never direct to a workman. This method will ensure that all material of this nature is weighed and charged up.

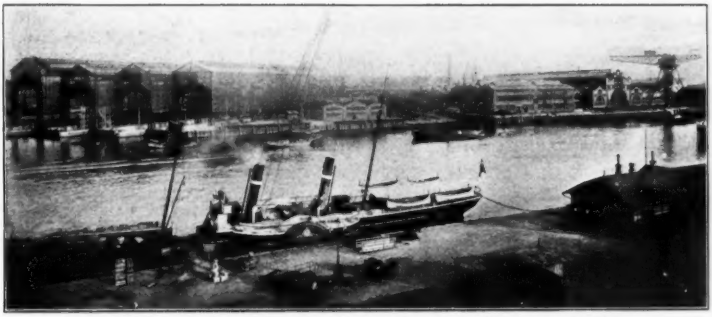
No scrap or rubbish of any sort should be allowed to lie about the shop. Iron or steel scrap must be removed to scrap heaps at frequent intervals, whilst metal scrap is returned to stores.

Odd appliances, such as straps and bolts used for machine work, should be kept in boxes alongside the machines and each workman should have a lock-up drawer or cupboard to accommodate his tools. No shelves should be allowed underneath the vise benches, as they are awkward to get at and are apt to become receptacles for scrap or rubbish.

Those accustomed to the order and cleanliness to be found in up-to-date works will perhaps be disposed to regard the above rules as superfluous, but a visit to one or two jobbing shops of the old-fashioned type will soon remove any such impression. I have seen small works of this nature where even the gangways were cluttered up with scrap and rubbish, whilst the proprietors were deploring the difficulty of making ends meet. In one such concern, valuable metal was lying about all over the place without any adequate check upon it, and there is no doubt that the owners were losing hundreds a year from pilfering alone, not to mention the waste of time entailed by such disorder. The British workman is fairly honest so long as temptation is not placed in his way, but experience proves that where valuable metal is not checked, it will certainly be stolen to a considerable extent.

Ths simple system will suffice for controlling a small jobbing and repair shop without by methods which have stood the test of practical experience. In fact, all the methods put forward are being extensively employed in large concerns in a more complex form. The storage of correspondence, drawings and other records have not been touched on, as the proceedure in large concerns is adaptable to these small undertakings with very slight modification, and modern practice in connection with such matters has been fully explained elsewhere.

Systematic methods are now indispensable in large undertakings, and they will certainly become equally necessary for small concerns as competition emphasises the vital importance of efficiency.



GENERAL VIEW OF THE GERMANIA SHIPYARDS (FIFTH GROUP).

THE KRUPP WORKS.

The brief data accompanying the following views are condensed from statistics obtained from the authorities of the Krupp establishments and supplied by C. Van Langendonck.

THE illustrations on the following pages might be regarded as an accompaniment to Dr. Junge's leading article in this issue, for they show objectively one of the characteristic institutions built up under German industrial policy—one in which the co-ordination of private and State interests is characteristically manifest.

The pictures are to a large extent left to tell their own story, but in further explanation it may be noted that the entire Krupp works comprises five separate groups employing nearly 60,000 workmen and 6,750 engineers and clerks, the total capitalization being about $43,000,000, and the management being carried on by a board of ten directors.

The five groups are, first, the Essen Steel Works, with proving grounds at Meppen, Tanger-Hütte and Essen; this group includes also the Milhofener-Hütte, with its four blast furnaces, the Hermann-Hütte, with three blast furnaces, and the Sayner-Hütte, with coal and iron mines, etc.; second, the Friedrich-Alfred Iron Works in Rheinhausen; third, the Annen Steel Works; fourth, the Gruson Machine Works at Magdeburg-Buckau; and, fifth, the Germania Shipyards at Kiel.

The Essen Steel Works alone comprise some sixty-odd departments, covering an area of about 500 acres and housing 7,200 machine-tools, 17 roll trains, 187 hammers, 81 hydraulic presses, 397 steam boilers and 569 steam engines, more than 2,200 electric motors, and 900 cranes. The coal consumption of the entire establishment is 2½ million tons a year. The characteristic product is steel (Bessemer, open-hearth, crucible, and alloy steels, armor-plate and ordnance).

The Friedrich-Alfred Hütte includes 6 blast furnaces, with 15 blast-furnace-gas-operated blowing engines, and Martin and Thomas steel works.

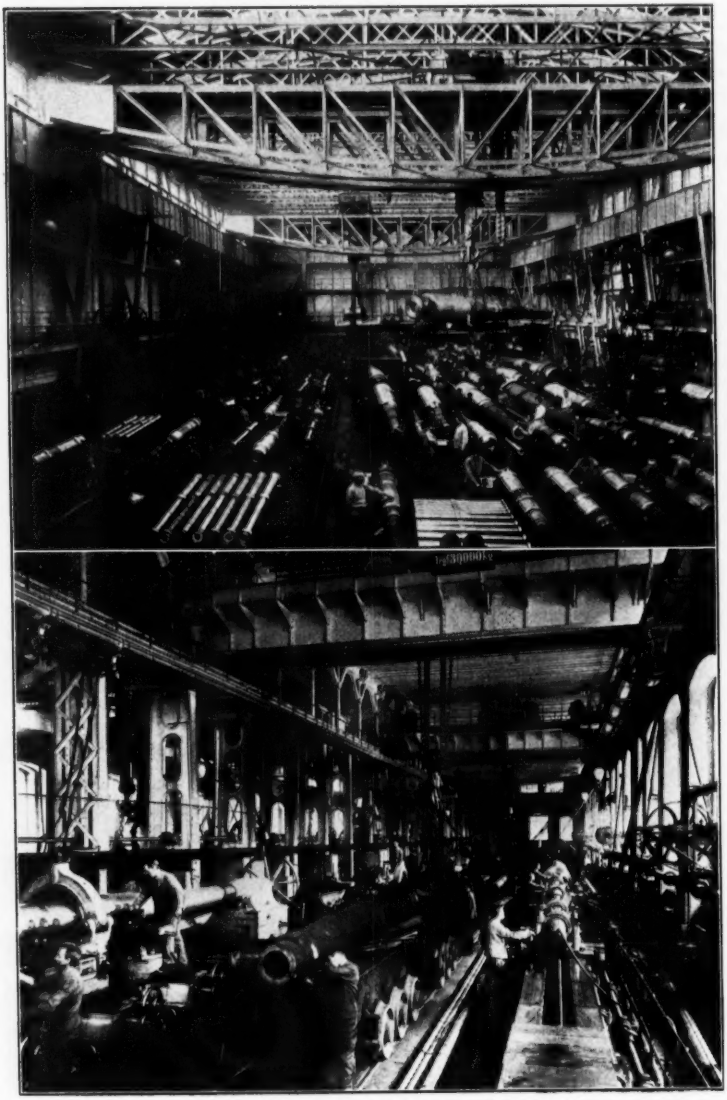
The characteristic product of the Annen Works (third group) is open-hearth and crucible-steel castings and finished steel castings up to 25 tons.

The Gruson Works at Magdeburg-Buckau are made up of more than 50 different shops, covering an area of 75 acres and housing 1,850 machine tools and nearly 500 cranes.

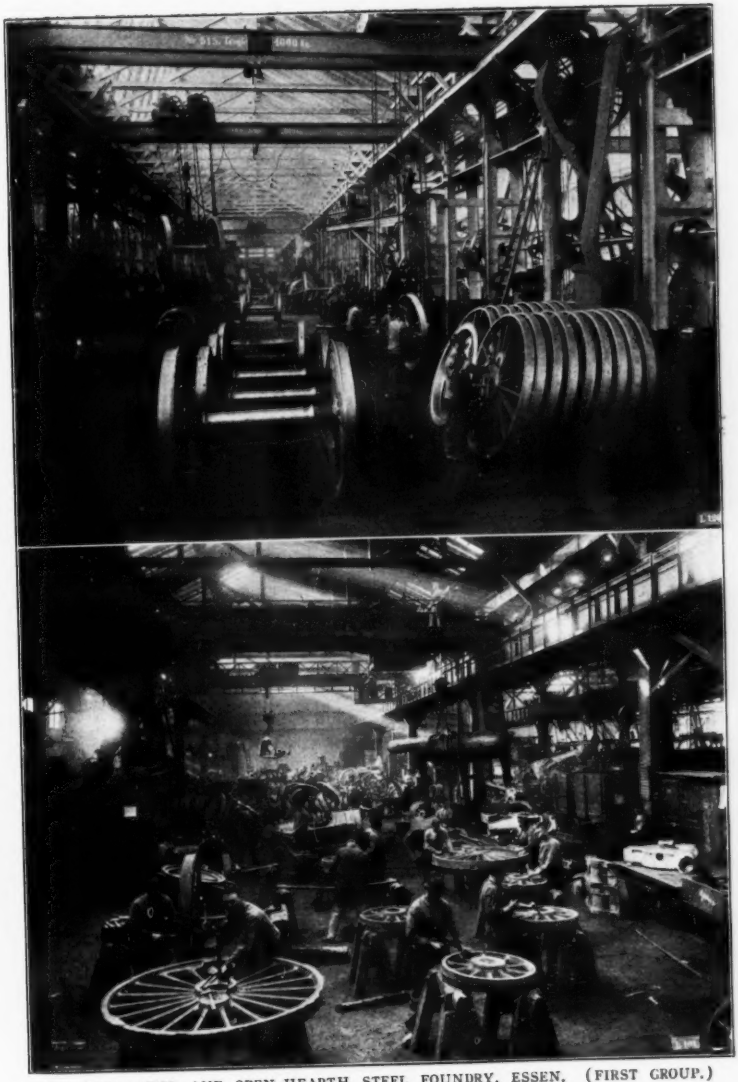
The Germania Shipyards cover an area of about 60 acres, with 8 building slips, of which the two largest can take vessels up to 725 feet long and 130 feet wide. Four of the slips are roofed. The forge shops cover nearly two acres; the main bay of the fitting shop is 475 feet by 78 feet, and the boiler shop is 400 feet by 212 feet.

THE LITTLE HOUSE IN THE CENTER OF THE PICTURE IS THE BUILDING IN WHICH THE FIRST KRUPP BEGAN THE PRESENT BUSINESS.

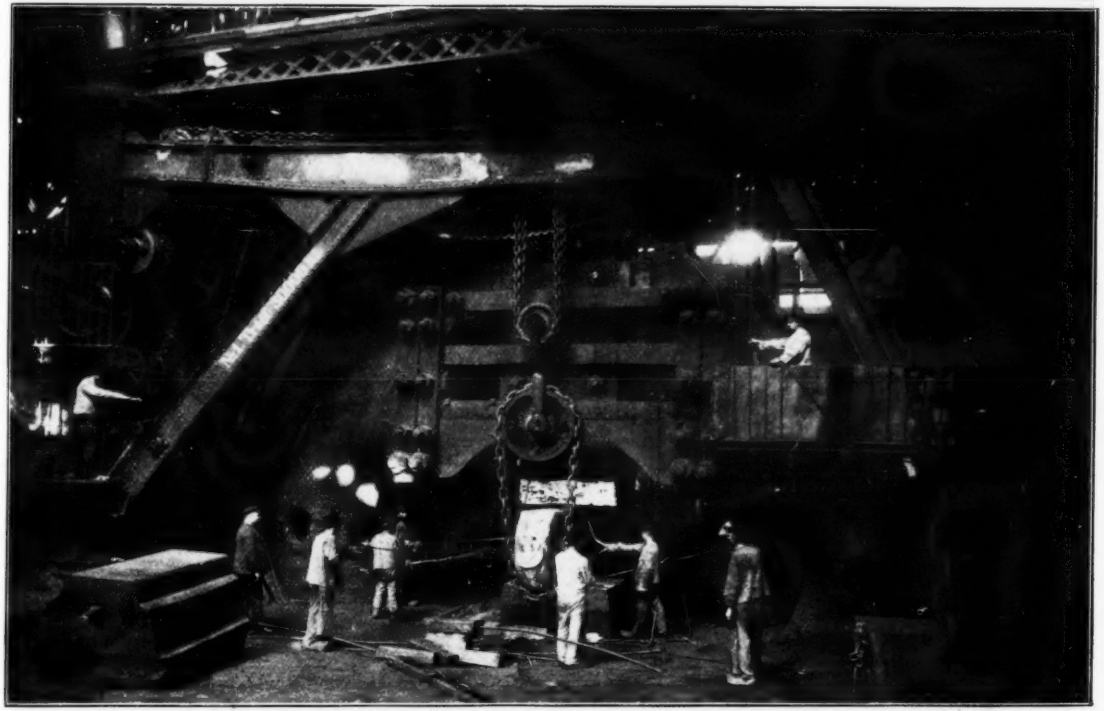
OPEN-HEARTH STEEL FOUNDRY NO. 3 (ABOVE) AND CRUCIBLE-STEEL FOUNDRY, ESSEN.
(FIRST GROUP.)



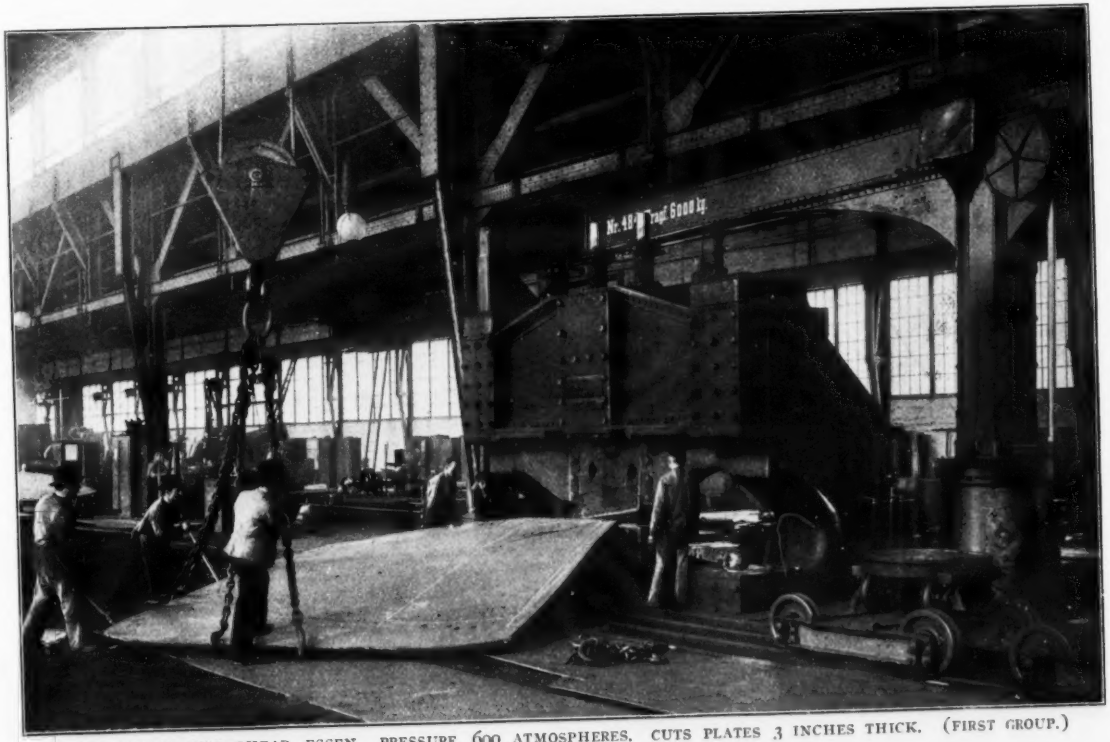
ORDNANCE SHOPS NO. 2 AND NO. 5, ESSEN.



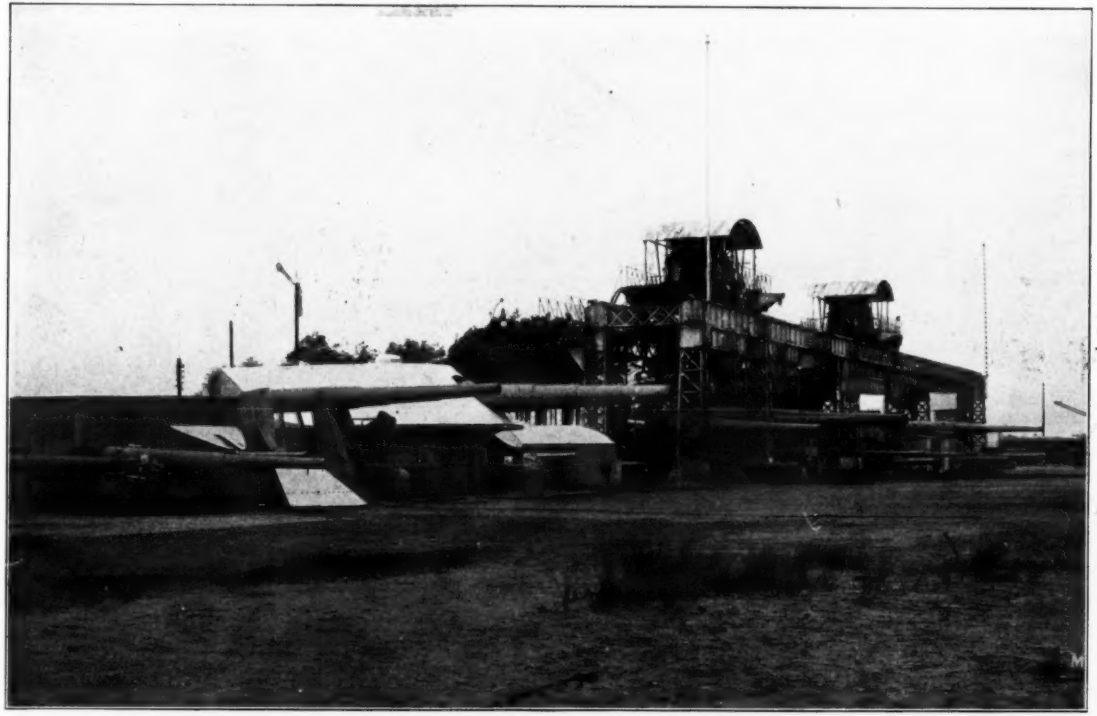
TURNING SHOP AND OPEN-HEARTH STEEL FOUNDRY, ESSEN. (FIRST GROUP.)



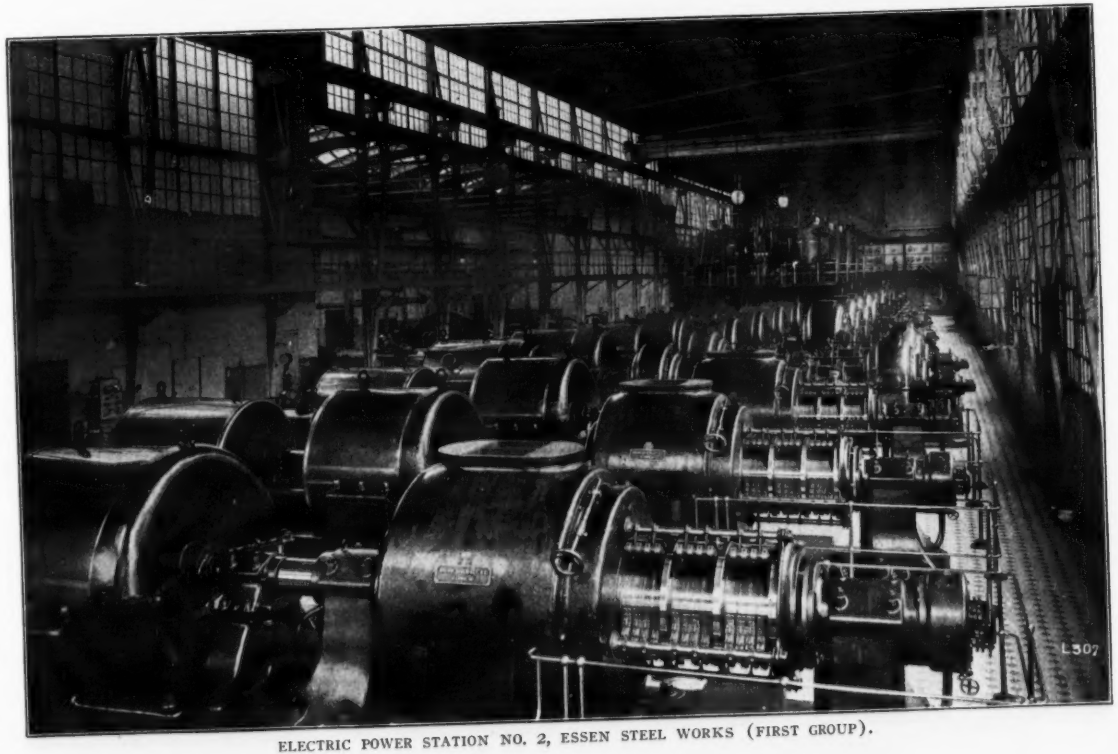
THE 50-TON HAMMER, "FRITZ," ESSEN STEEL WORKS.



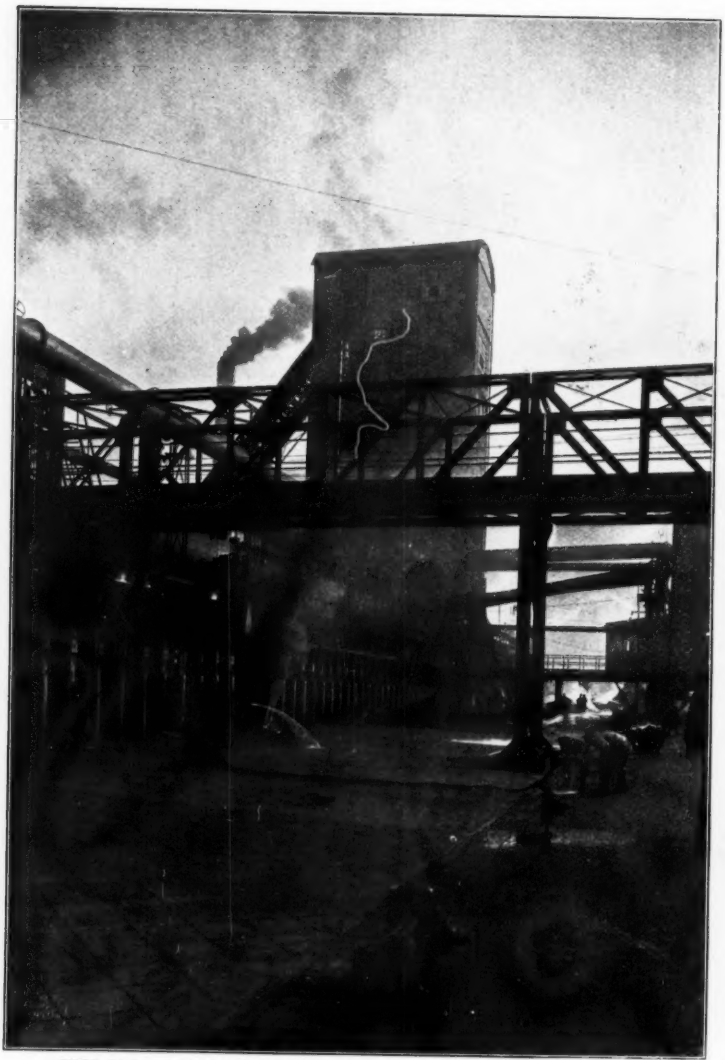
HYDRAULIC COLD SHEAR, ESSEN. PRESSURE, 600 ATMOSPHERES. CUTS PLATES 3 INCHES THICK. (FIRST GROUP.)



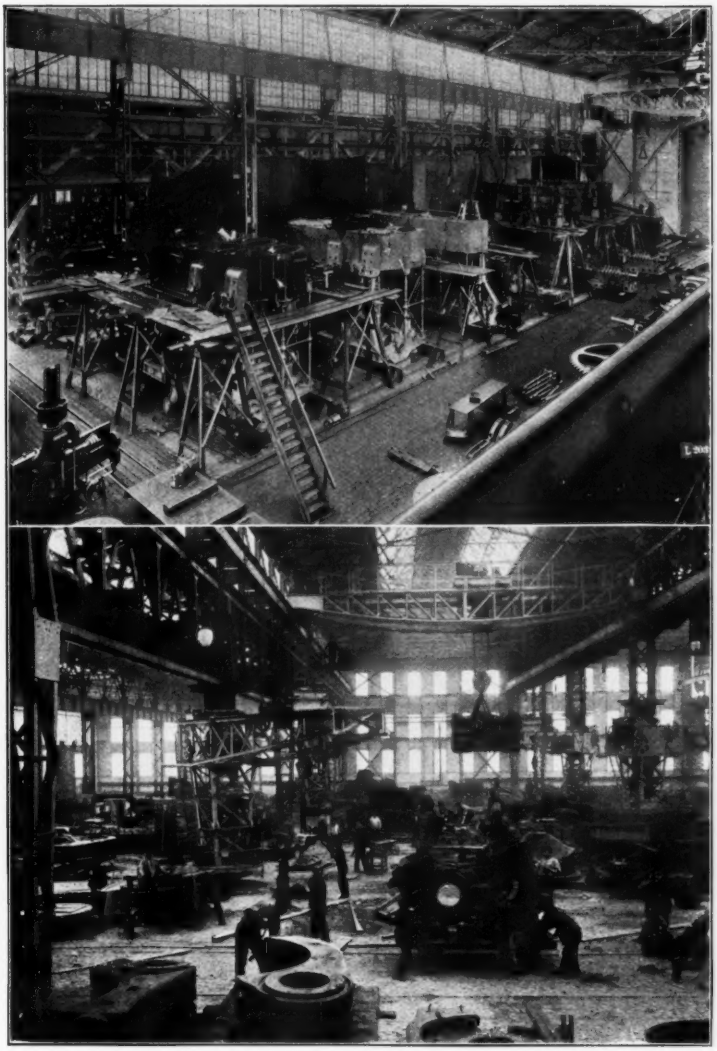
PROVING GROUND AT MEPPEN (FIRST GROUP).



ELECTRIC POWER STATION NO. 2, ESSEN STEEL WORKS (FIRST GROUP).



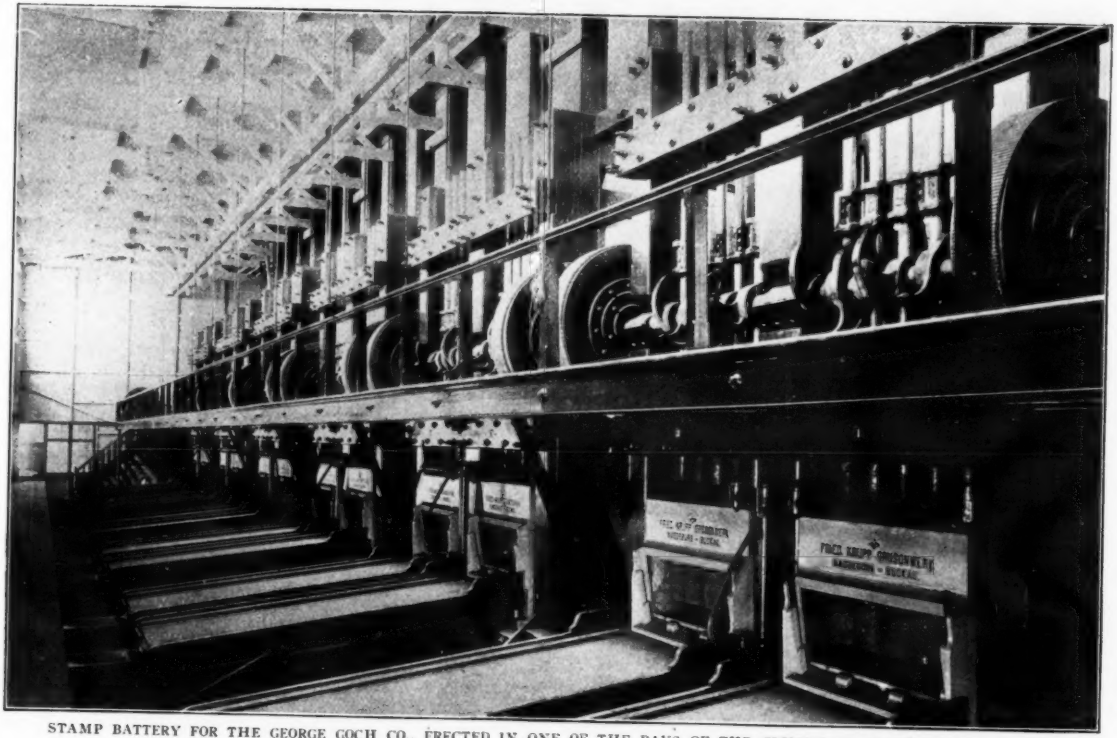
COKE OVENS, VER SAELZER AND NEUACK COAL MINES (FIRST GROUP).



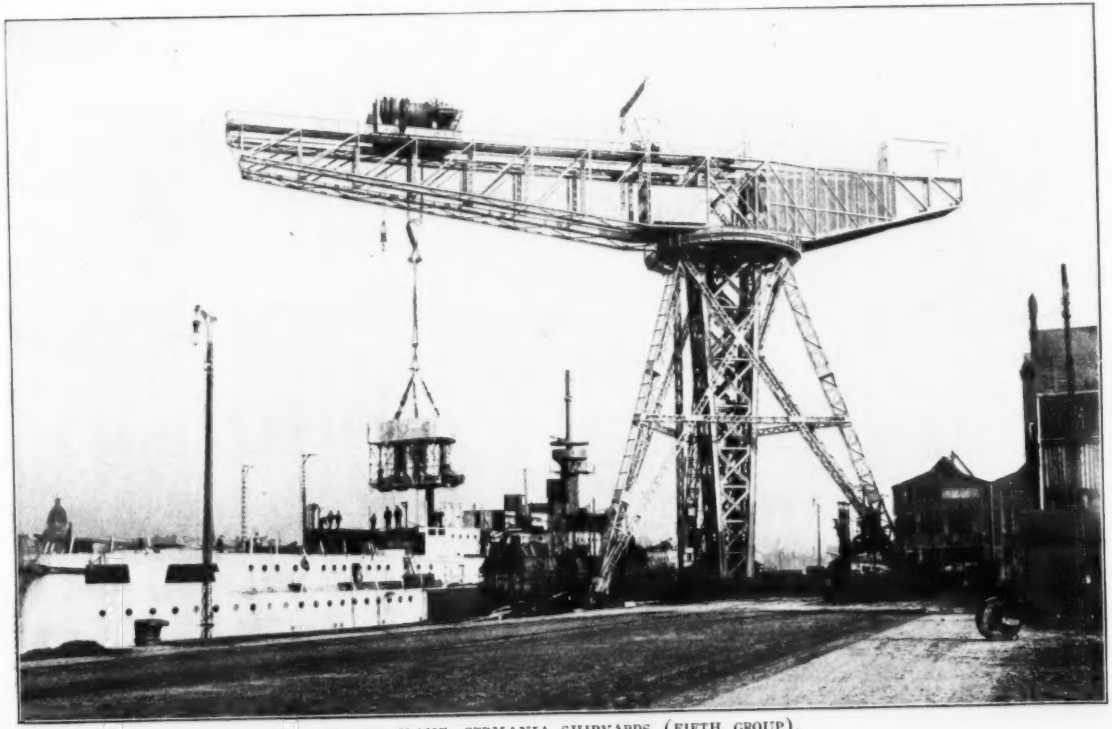
ERECTING SHOP AND IRON FOUNDRY, GERMANIA SHIP YARDS (FIFTH GROUP).
The engines assembled are for the warship Deutschland, the transport Borussia, and the coastguard vessel Assar-i-Tewfik.

ORE-HANDLING MACHINERY, FRIEDRICH-ALFRED HÜTTE (SECOND GROUP).

TRIO OF 700-CENTIMETRE ROLLS, FRIEDRICH-ALFRED HÜTTE (SECOND GROUP).



STAMP BATTERY FOR THE GEORGE GOCH CO., ERECTED IN ONE OF THE BAYS OF THE GRUSON WORKS (FOURTH GROUP).



150-TON CRANE, GERMANIA SHIPYARDS (FIFTH GROUP).

THE PURCHASE OF COAL BY SPECIFICATIONS.

By Leo Loeb.

EVERY working day in the year the coal miners of the United States are preparing for public consumption 1,600,000 tons of coal, ranging in quality from the peats of Florida and the lignites of New Mexico to the anthracites of Pennsylvania and the semi-bituminous coals of West Virginia. The value of this product per annum is $1,360,000,000, as compared with $530,000,000 for pig iron, $164,800,000 for iron ore, $174,000,000 for copper, $90,440,000 for gold, and $37,300,000 for silver. Of this total production the steel industry is the largest consumer with 100,000,000 tons per annum; next the railroads which manage to burn usefully 70,000,000 tons while wasting 20,000,000 tons; followed by the Government, with a consumption of 2,000,000 tons; and finally the domestic users and unclassified industries. The total market value is a little lower than that of all the other mineral products of the United States.

In the majority of cases, and certainly by the largest number of individual consumers, less care is exercised in the purchase of this necessary commodity than in supplying any other need of industrial and domestic America.

Legally a contract is an agreement between two capable parties whereby one agrees to perform a service or furnish a definite article to the other for a consideration, yet the form of coal contract that is entered into by users, and the character of the product delivered to them, would indicate that they were far from capable parties.

The conservation movement has brought very forcibly to our attention the fact that the known supply of solid fuel is limited and a warning to observe care is clearly given; but in spite of that, such indefinite stipulations as "run of mine coal of good quality, reasonably free from dirt and slate" are only too common. What a different story when the article has greater bulk value, as iron ore, wood pulp, yarn, gunpowder, steel rails.

The object of any specification is to protect the consumer against inferior goods and to relieve him from continued anxiety over the cost of producing his output as affected by fluctuations in the quality

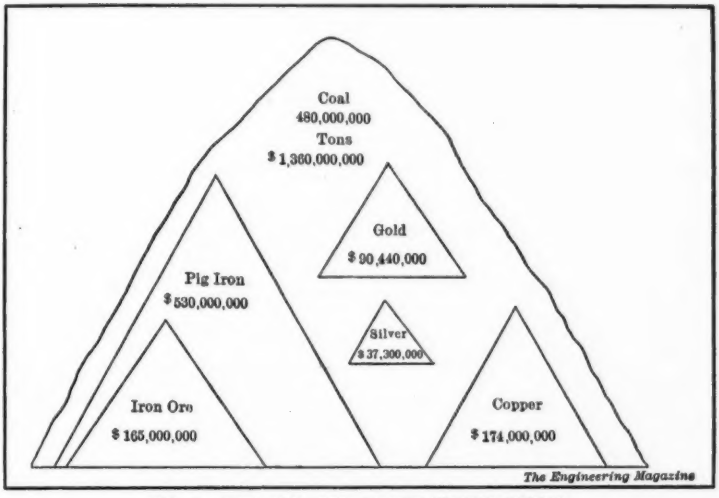


FIG. I. THE COAL PILE OF THE UNITED STATES.

of the raw materials. Of course, the exact form of specification—absolute uniform quality, or payment proportionate to quality—varies with the character of the material furnished under the contract. But if the consumer gets what he pays for, then the operator should get paid for the quality supplied.

The consumption of coal produces heat, and in general the manifestation of this is in the evaporation of water; so to insure the coal cost of a unit of output remaining constant, the manufacturer wants assurance that the cost of unit steam shall be constant. Figure 2 shows the variation in price per ton of coal and cost of steam production with quality under various forms of contracts.

In case I the price per ton is constant regardless of quality, and the cost of generating steam increases with decline of quality. In case II a penalty is exacted without a corresponding bonus. Then the price is adjusted in proportion to quality below standard, and the cost of generating steam is constant only so long as these adjustments are made. The dealer does not then benefit by supplying fuel above contract grade. In the third case the penalty and bonus are not in the proper proportion, and if the cost of generating steam is constant during portion of fulfilment of contract, it will not be so during the remainder. But if an entirely equitable basis of penalty and premium can be applied to all deliveries, the plant operation is not influenced by fluctuations in quality of coal delivered, and pay-

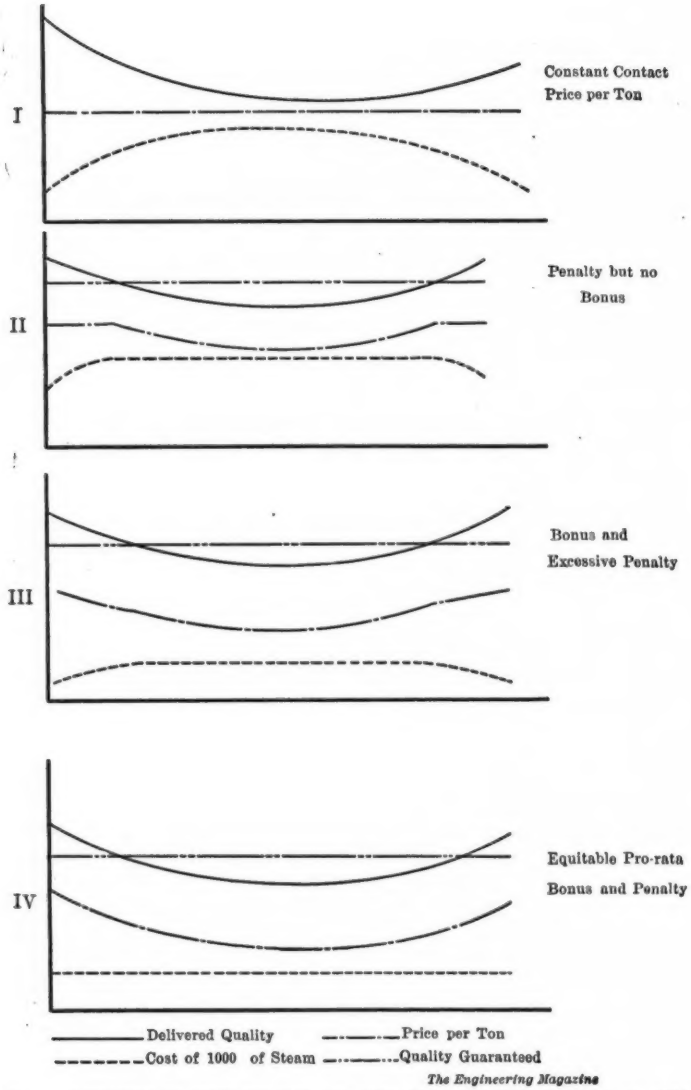


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FIG. 2. VARIATION OF PRICE PER TON AND COST OF GENERATING 1,000 LB. OF STEAM WITH QUALITY OF COAL DELIVERED.

ment is always adjusted to quality. Such conditions are shown graphically in diagram IV.

Thus the problem in drafting a coal contract is to keep the cost of a unit of steam generated constant under all conditions of delivery of that coal. In this the proposition is no different from that in ore purchases, where payment is made on pure metal per ton of ore.

With this in view it is necessary to examine carefully the physical characteristics of coal with a view to determining the effect of these characteristics on the efficiency of steam generation. The so-called proximate analysis divides the constituents into groups which may be examined for the various effects.

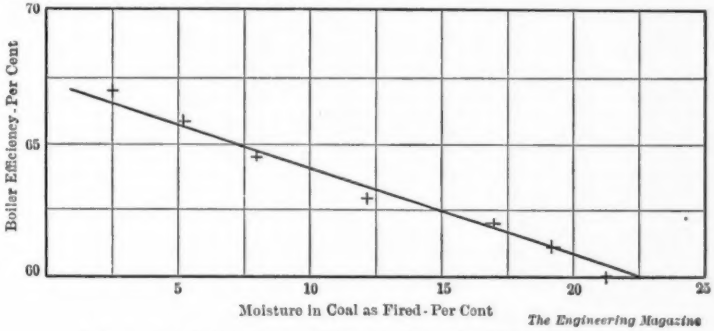

FIG. 3. RELATION OF MOISTURE IN COAL TO BOILER EFFICIENCY.

(1) Moisture in the coal comes from three sources—inherent moisture from the mine, moisture absorbed in transit, and water poured on the coal by the seller. In any case it has no heat value; it is just so much dead weight, whatever may be its effect in caking the fine coal, preventing undue waste through the grates, minimizing the formation of clinker and reducing the nuisance of flying dust. In just so far as the water in coal affects the weight delivered, so it affects the storage capacity of the bins and the ease in drawing the supply from the bunkers. Again, the presence of water aids the slow oxidation of coal in storage and may in certain cases be the cause of spontaneous combustion. The effect on boiler efficiency is not as yet a settled thing. Although it requires just as much heat to separate a given quantity of water into its constituent elements of hydrogen and oxygen as are yielded when they again unite by combustion, recent tests confirm the belief that the presence of the hydrogen in contact with unburned carbon is an aid to complete combustion. In any case, moisture is much more economical through a water meter at 8 cents per thousand gallons than in a coal wagon at $3.50 per ton.

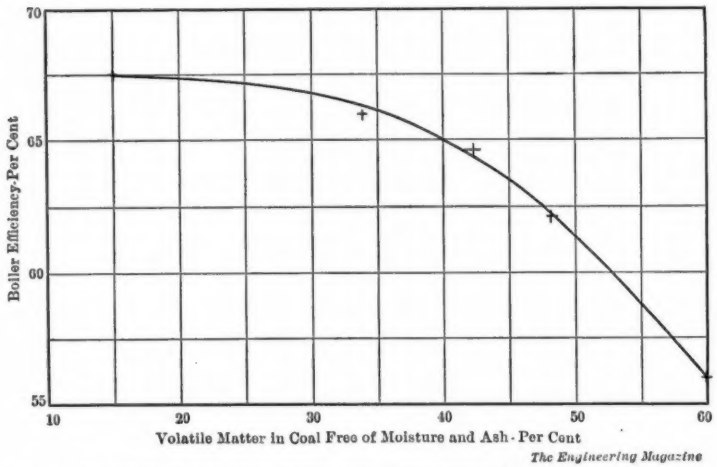

FIG. 4. RELATION OF VOLATILE MATTER IN "COMBUSTIBLE" TO BOILER EFFICIENCY.

(2) Volatile matter in coal is that portion, other than water vapor, which passes off as a gaseous product when coal is heated in a closed vessel. The total amount of such volatile matter is as low as 3 per cent in Pennsylvania anthracites, 20 per cent in the best eastern American semi-bituminous coals, and ranges upward for the western coals and lignites. But the remarkable part is the recently established fact that all coals contain from 1 per cent (Eastern coals) to 15 per cent (Western coals) of absolutely inert gases: carbon dioxide, nitrogen, ammonia—with no heat value.

The volatile matter evolved from the younger coals of the West includes a large proportion of carbon dioxide, carbon monoxide, and water, and a correspondingly small amount of hydrocarbons and tarry vapors. The older bituminous coals of the Appalachian region yield volatile matter containing large amounts of tarry vapors and hydrocarbons, difficult to burn completely without a considerable excess of air and a high temperature. Coal of the Western type, moreover, gives up its volatile matter more easily at high temperatures than coal of the Eastern type. The volatile matter produced at medium temperature is rich in higher hydrocarbons of the methane type, such as ethane and propane, which contain a larger proportion of carbon than is present in methane.*

This taken with the order of yield of volatile matter—first inert gases and illuminants, then hydrogen—gives the volatile matter as an index of the liability to produce smoke, danger of combustion in storage, and effect on boiler efficiency.

* "The Volatile Matter in Coals," Bulletin 1, U. S. Bureau of Mines, 1910.

(3) The fixed carbon in the coal requires no particular attention, since it will take care of itself by difference if the other constituents are properly balanced. The character of carbon, whether coking or non-coking, is important, but that is always a known characteristic of any coal field.

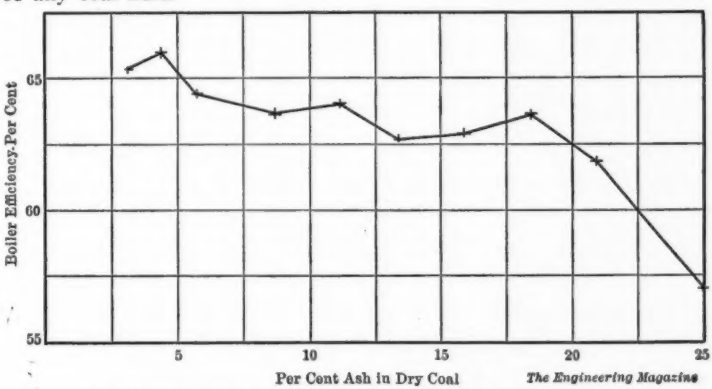

FIG. 5. RELATION OF ASH IN DRY COAL TO BOILER EFFICIENCY.

(4) Ash. The reasons for keeping the proportion of ash as low as possible are certainly obvious. It is so much inert matter when purchased and stored, it increases the labor of firing and cleaning the fires, it entails the extra cost of providing for its removal as refuse, it lowers the boiler rating and capacity, and it materially affects the boiler efficiency, as is shown on the accompanying diagram from a series of nearly 300 tests with different coals on a 250-horse-power Heine boiler. All the high-efficiency tests are on coals low in ash. The curve shows an average decrease of 1 per cent in boiler efficiency for each 1 per cent increase in ash. As regards amount of rated capacity obtained—a coal with 5 per cent ash shows 95 per cent rated capacity, while a 19 per cent ash shows only 84 per cent capacity.

(5) Sulphur occurs in coal in three forms: iron pyrites, free sulphur, and gypsum. The former is the more harmful, as it fuses together and forms a dense clinker which freezes to the grate bars, can be removed only with difficulty, and chokes off the draft. It is doubtful if the sulphur exerts any considerable corrosive effect on the boiler but the gases of combustion are frequently a nuisance.

(6) The sizing of the coal is important in regard to adapting any particular coal to the installation and to convenience in handling, but does not enter into the basis of payment. Tests show that small sizes in bituminous coals have the greatest efficiency, but that is un-

doubtedly due to the fact that the best American coals are very friable and break up in transit and in storage.

(7) Heating value in British thermal units per pound. This is without doubt the most important feature of any coal contract, because, although the boiler efficiency varies only slightly with heat content of the coal, the amount of steam generated per pound is directly proportional to the heating value of the coal. Likewise the boiler capacity is affected in proportion to the available heat in the coal. This heating value is influenced by moisture, ash, sulphur, and by the proportion of hydrogen to carbon.

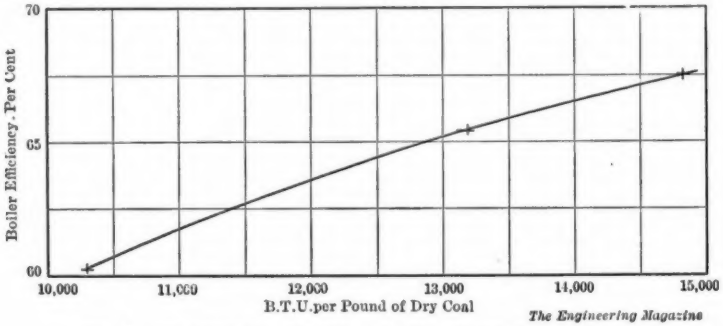

FIG. 6. RELATION OF B.T.U. IN DRY COAL TO BOILER EFFICIENCY.

Having considered the effects of the various constituents of the coal we are ready to undertake the drafting of a contract form. First, such general clauses as are required to make the contract valid in a court of record, as time and place of opening bids, evidence of good faith, quantities of fuel desired and place of delivery, weighing and the right to reject bids or terminate contract for cause.

Next should follow the clauses specifying who should do the sampling and analysis and what standards are to be used by them. It is better to ask for coal of approximate quality and allow the bidder to specify the exact quality he proposes to furnish, unless for unusual reasons a certain grade must be had. Then the bidder bears the responsibility of furnishing the particular coal guaranteed. The outside limits of ash, sulphur, and volatile matter, above which coal delivered on contract may be rejected, must be clearly specified and space provided for location of mine or group of mines from which the coal is to be supplied, so that the consumer may investigate and determine whether the coal offered is suitable for his needs. Finally, tables of deductions or premiums must be included.

As already mentioned, the moisture, ash, sulphur and inert vola-

tile matter directly affect the heating value of the coal, so that the B. t. u. as delivered take entire account of such of these as effect capacity and not efficiency. It would be manifestly unfair to penalize for excess moisture and again for decreased heat value as received, for they are merely cause and effect.

The same is true for ash as far as it affects the quality of the coal, but it was pointed out that excess ash also causes extra labor of firing, expense of removal of refuse, and decreased efficiency of boiler, so that an extra penalty should be imposed for such excess and a corresponding bonus paid for deficiency.

A table is given for all ash guarantees from 5 per cent to 19 per cent, based on cost of disposal of refuse at 35 cents per cubic yard, coal at $3,00 per ton, hand firing, and decrease of boiler efficiency of 1 per cent for each 1 per cent ash, with an allowance of 1 per cent before deductions begin. The 1 per cent allowance is to provide for errors in sampling and slight latitude for deliveries.

TABLE OF PENALTIES FOR ASH IN EXCESS OF GUARANTEE.

Ash in dry coal guaranteed.	Deductions in cents per ton.					
	3½	7	10½	14	17½	21
5	6-7	7-8	8-9	9-10	10-11	11-12
6	7-8	8-9	9-10	10-11	11-12	12-13
7	8-9	9-10	10-11	11-12	12-13	13-14
8	9-10	10-11	11-12	12-13	13-14	14-15
9	10-11	11-12	12-13	13-14	14-15	15-16
10	11-12	12-13	13-14	14-15	15-16	16-17
11	12-13	13-14	14-15	15-16	16-17	17-18
12	13-14	14-15	15-16	16-17	17-18	18-19
13	14-15	15-16	16-17	17-18	18-19	19-20
14	15-16	16-17	17-18	18-19	19-20	20-21
15	16-17	17-18	18-19	19-20	20-21	21-22
16	17-18	18-19	19-20	20-21	21-22	22-23
17	18-19	19-20	20-21	21-22	22-23	23-24
18	19-20	20-21	21-22	22-23	23-24	24-25
19	20-21	21-22	22-23	23-24	24-25	25-26

Except in cases where the presence of a moderate amount of sulphur is harmful, no penalty is exacted, as it is difficult to arrive at a basis of such deductions, and experience has shown that the sulphur in coal from one district varies slightly. The same can be said of volatile content, where our knowledge is as yet too meagre to allow of an equitable correction. Actual contracts will be cited where both of these factors, however, are involved.

The method of arriving at the successful bidder in any case of bids submitted on a heat value proposal is to compute on each guarantee the net B. t. u. for 1 cent, or the cents per million B. t. u. The

net B. t. u. for one cent is computed in the following manner: The product of the number of cents per ton correction for ash variation multiplied by the variation is added to all prices other than that of the coal of lowest ash content. This adjusts all prices to one level. Then the net B. t. u. for 1 cent is B. t. u. offered multiplied by pounds per ton divided by corrected price. As an example, take the case of four bids submitted on 1,000 tons run-of-mine coal for the Buffalo Post Office for the year 1909-1910.

Bidder.	B.t.u. as rec'd.	Ash in dry coal.	Price.	Price cor. for ash.	B.t.u. for 1 cent.	Cents per million B.t.u.
A.....	13,485	7.84 per cent	$2.90	$2.957	102,152	9.789
B.....	13,791	6.63 "	2.79	2.823	109,429	9.138
C.....	13,900	6.50 "	2.90	2.930	106,266	9.410
D.....	14,100	5.00 "	2.84	2.840	111,211	8.992

$$\frac{13{,}485 \times 2240}{295.7} = 102{,}152 \text{ B.t.u. for 1 cent.}$$

The second lowest cash price per ton proves to be the cheapest, since for each cent D will furnish 111,211 B. t. u., while his nearest competitor can only give 109,429—nearly 2 per cent less. The ash correction in these bids is 2 cents for 1 per cent. D is entitled to the contract, unless it be determined on trial that the fuel he proposes to furnish cannot be economically burned in the equipment at Buffalo.

The practice followed in certain places of basing the bid on the analysis of a small sample accompanying the bid is to be discouraged, as the coal dealer's sample is generally selected and appears better than the samples from actual delivery; the penalty that results is one source of discontent on the part of dealers. The more satisfactory plan is to have a guarantee accompany the bid with a geologic description of the coal to be furnished. Thus it is easy to see when a bid is doctored to make the ash correction a disadvantage to the *bona fide* bidders.

It should be noted at this point—as will appear from further illustrations of forms of contracts—that the amount of ash correction under several forms of contracts will seldom, if ever, affect the award as between two parties, unless their bids be very close, and in that case the benefit should be thrown to the coal of best trade record.

The following are a few forms of coal specifications covering large deliveries. The Interborough Rapid Transit Company purchases a year's supply of 360,000 tons of run-of-mine bituminous with the desired analysis on dry coal of carbon, 71 per cent; volatile,

20 per cent; ash, 9 per cent; B. t. u., 14,100 per pound; and sulphur, not over 1.5 per cent.

Premiums or deductions on heat value are based on a rate of 1 cent per ton for each 50 B. t. u. per pound of coal; for each ½ per cent of volatile matter in excess of 21 per cent, 2 cents per ton is deducted; for each ½ per cent of ash in excess of 9 per cent, 2 cents per ton is deducted; and for each ¼ per cent of sulphur in excess of 1.5 per cent, a deduction of 6 cents is made.

The inequitable features of this contract are excessive penalties in the case of sulphur and of volatile matter, and deductions without corresponding premiums in the case of volatile matter, ash, and sulphur. Furthermore, no incentive is offered to the dealer to deliver coal low in moisture since heat value is reckoned on the "dry" basis instead of "as received," whereas it was clearly pointed out that B. t. u. in commercial coal is the only true basis of potential heat.

The coal for the Panama Canal, consisting of bunker coal for vessels, locomotive coal, and fuel for dredges and steam shovels, aggregating 650,000 tons per annum, is purchased on a desired quality of 14,600 B. t. u. as received, with acceptance down to 14,350 B. t. u. on deduction of ¼ cent per 25 B. t. u. or fraction thereof. Coal analyzing below 14,350 B. t. u. and on a dry basis less than 14,750 B. t. u. is penalized 1 cent for each 25 B. t. u. below 15,000 in addition to the penalty above noted. This, in effect, is an ash adjustment, since previous experience had shown that the coal desired had a value, dry coal, of 14,900 B. t. u. This is a severe contract in that it gives no premiums, but is justified by the fact that, although the prices f. o. b. vessel at Norfolk were $2.72½ per long ton in 1908, $2.44 per long ton 1909, and $2.60 in 1910, the cost amounts to almost $6.50 per ton before the coal is distributed to shovels and dredges. This contract has resulted in an average delivery for 1908 of 14,547 B. t. u. as received, for 1909, 14,528, with a banner cargo in 1909 of 5,021 tons moisture 2.06 per cent, ash 3.69 per cent, B. t. u. as received 14,888, and B. t. u. dry coal 15,200.

The Government's coal purchases amount to about $7,000,000 per annum. Half of this is used in war vessels and is purchased by a system of visual inspection which will not permit of wet coal being loaded, and which pays a premium for all coal showing more than 15,000 B. t. u. dry. The remaining million tons is purchased on a *pro rata* "as received" B. t. u. basis and an ash variation allowing 2 per cent, then penalizing at rates increasing from 2 cents to 35 cents per ton for from 3 per cent to 9 per cent ash above guarantee. The criticism of this contract is that it has a rather large ash

EVAPORATION TESTS OF TWO COMPETING COALS.

Duration of test, hours	9	9	9	9
Name of coal	Elk Lick.	Orenda.	Orenda.	Elk Lick.
Analysis:				
Moisture	1.80	2.10	2.70	5.80
Ash	9.10	8.20	9.30	8.30
Fixed carbon	68.60	73.70	71.50	65.90
Volatile matter	20.50	16.00	16.50	20.00
B.t.u. as received	14,050	14,070	13,770	13,565
B.t.u. dry coal	14,310	14,370	14,150	14,400
Refuse:				
Combustible matter	22.75	30.10	20.80	21.00
Non-combustible	77.25	69.90	79.20	79.00
Per cent refuse	12.86	9.73	9.74	10.46
Boiler horse power	426.5	421.8	426.8	455.2
Equivalent evaporation per lb. coal as received	10.25	10.51	9.97	9.92
Equivalent evaporation per lb. dry coal	10.44	10.74	10.25	10.52
Equivalent evaporation per lb. combustible	11.98	11.90	11.35	11.75
Efficiency of boiler and grate, per cent	70.45	72.18	69.95	70.55
Contract price, per ton	$3.01	$3.15	$3.15	$3.01
Ash in dry coal, per cent	7	6	6	7
B.t.u. as received	14,000	14,300	14,300	14,000
Smoke, per cent black	15.2	1.7	3.62	13.8
Cost of evaporating 1,000 lb. of steam under observed conditions, cents	13.08	13.09	13.69	13.12

margin, that penalties are excessive for greatest departure from contract, ash premiums (1 cent per 1 per cent) are not in proper proportion to ash penalties, and ash penalties do not change with price.

A western firm handles large contracts for clients in Chicago and vicinity based on net B. t. u., which, to quote from their form is arrived at as follows: "Multiply the number of B. t. u. dry coal by the per cent moisture expressed in decimals, subtract the product so found from the number of B. t. u. per pound of dry coal, multiply the remainder by 2,000 and divide this product by the contract rate per ton (expressed in cents), plus one-half of the ash percentages (expressed as cents)." To drop the formidable language of the circular this amounts to making a correction to the price of one-half cent for each 1 per cent ash, and computing B. t. u. for 1 cent on the "as received" basis. Payments on delivery are adjusted in proportion of the net B. t. u. delivered to the net B. t. u. as guaranteed. The defect of this form is that it does not give an increasing deduc-

tion for increased percentages of ash over contract to provide for decreased boiler efficiency, and that one-half cent per 1 per cent is too low to cover the extra labor and cost of removal of ash under the most favorable conditions. In its practical applications however, it usually gives corrected prices which are very close to those under the form proposed and the one used by the United States Government.

To summarize the effects of these bases of payment, there are given data from a case which arose in a power plant this past summer. Among the half-dozen bidders was the agent then holding the contract, with a bid of $3.15 for 6 per cent ash in dry coal and 14,300 B. t. u. as received, and the nearest competitor $3.01, 7 per cent, 14,000 B. t. u., giving 9.84 and 9.66 cents per million B. t. u.—a ratio of 1.018. The first had supplied satisfactory coal for a year; the second from records in the Bureau of Mines was known to be slightly inferior and probably not so well adapted to the installation. But since there was a possible saving of 1.8 per cent, it was decided to leave the results to evaporation tests on two Babcock & Willcox boilers of 206 boiler horse power, fitted with mechanical stokers. The results are given in the table on the opposite page.

The average cost of producing steam with Elk Lick coal is 13.10 cents per thousand pounds and with Orenda 13.39 cents per thousand pounds, a ratio of $\frac{13.39}{13.10} = 1.021$, a saving in favor of the first of 2.1 per cent, whereas the expected saving was 1.8 per cent.

No Specifications.		Specifications.		Chicago Specifications.	
Price per ton	Evaporating 1000 lb. of steam	Price per ton	Evaporating 1000 lb. of steam	Price per ton	Evap. 1000 lb. of steam
$3.01	13.33 cents	$2.959	13.10 cents	$2.960	13.10 cents
3.15	13.73 "	3.036	13.39 "	3.047	13.44 "

Thus the specifications are seen to keep the cost of producing steam constant under variations of delivery—the original basis for the matter.

The question of correct sampling of coal is one to which could be devoted a great deal of time, for it has some very interesting phases. Any reliable laboratory can make a coal analysis, but such analysis for the purpose of forming a basis of payment is worse than useless unless the sample be absolutely representative of the coal in moisture content, proportion of lump and fine coal and amount of impurities. Not only must the sampler be fair and unbiased, but he should have had experience in the work.

The following general rules should apply:

Take no sample under 100 pounds.

A single sample should not represent more than 500 tons.

Sample at the time the coal is weighed.

Immediately reduce the sample, under shelter, to the size required by the laboratory.

No part of a sample once taken should be rejected—the law of chance applies, and if any part is worthless, all is worthless.

In many cases the coal dealers are antagonistic to specifications, and it is with great difficulty that they can be persuaded that this form of contract is equitable to both parties. In this respect they cannot be blamed when penalties are imposed without corresponding premiums. If the stipulations are fair, contractors will not hesitate; in fact such mining companies as employ competent fuel engineers and know the quality of their output solicit business on this basis. The anthracite combines will not guarantee the quality to dealers, consequently the latter have to stand any loss incurred in penalties.

A very natural question is "How much will the system cost?" That of course depends on the facilities of the plan for taking samples and making analyses. Many industrial plants already employ chemists, and the additional cost is the calorimeter apparatus, which can now be purchased in substantial form for $120. Commercial laboratories charge as much as $10 for a single analysis, but the rate is much lower where the work extends over a period. Some laboratories are prepared to take over the entire supervision of coal supply at a percentage of the annual saving effected; others go so far as to manage the plant for a fixed cost, taking as their fee the saving effected in firing, oil, and waste. The cost for a complete proximate analysis and calorific determination in the inspection laboratory of the Government is $1.95 per sample. This is probably as low a figure as can be reached.

The tonnage that may economically be purchased on specifications depends on the quantity delivered at one time. It has been successfully applied to an annual consumption of 500 tons, where the entire amount is placed in bunkers at one time.

In conclusion I present a table of prices and guarantees over the four years during which such fuel supply has been on specifications. The points of delivery are public buildings in Washington, New York and St. Louis, and with the single exception of the fourth plant, where coal is dumped directly from railway cars, all are supplied by wagons. The general trend of prices in the face of an advancing market is certainly worthy of careful consideration on

the part of any purchasing agent who contracts with operators for comparatively large tonnage of coal.

City.	Tons.	1908. Price.	Ash in dry coal. per cent	B.t.u. as rec'd.	1909. Price.	Ash in dry coal. per cent	B.t.u. as rec'd.
Washington...	7,000	$3.55	6.0	14,600	$3.35	5.7	14,600
" ...	500	3.98	6.0	14,600	3.55	5.7	14,600
" ...	350	4.03	6.0	14,600	3.55	5.7	14,600
" ...	21,000	3.50	7.5	14,300	3.05	7.5	14,300
" ...	3,600	Not on specifications			3.65	8.0	14,200
New York....	11,000	3.45	6.8	14,315	3.43	8.0	14,000
"	2,500	Not on specifications			2.82	13.34	12,000
"	4,000	Not on specifications			3.10	18.0	11,150
St. Louis.....	4,500	2.55	12.0	12,500	2.53	7.74	12,061
			1910.			1911.	
Washington...		$3.04	5.0	14,750	$3.19	4.0	14,710
" ...		3.14	5.0	14,250	3.30	5.0	14,700
" ...		3.14	5.0	14,250	3.35	5.0	14,700
" ...		3.00	6.0	14,250	2.80	7.0	14,000
" ...		3.50	7.0	14,250	3.23	7.0	14,200
New York ...		3.37	6.0	14,000	3.31	6.0	14,100
" ...		2.80	15.0	12,000	2.44	17.0	12,000
" ...		3.05	18.0	11,150	2.90	16.0	11,500
St. Louis.....		2.20	10.0	12,585	2.43	10.0	12,000

ACTUAL B.T.U. FOR ONE CENT.

City.	1908.	1909.	Change from 1908.	1910.	Change from 1909.	1911.	Change from 1910.
Washington	92,124	97,624	+ 5,500	108,684	+11,060	103,293	— 5,391
"	82,171	92,124	+ 9,953	101,650	+ 9,526	99,782	— 1,868
"	81,151	92,124	+10,973	101,650	+ 9,526	98,293	— 3,357
"	91,520	105,023	+13,503	106,400	+ 1,177	112,000	+ 5,600
"		87,145		91,200	+ 4,055	98,477	+ 7,277
New York.	92,944	91,428	— 1,516	93,056	+ 2,628	95,420	+ 2,364
"		95,320		96,000	+ 680	110,164	+14,164
"		80,568		81,889	+ 1,321	88,828	+ 6,939
St. Louis...	109,804	106,785	— 3,019	128,138	+21,353	110,617	—17,521

PERCENTAGE CHANGE IN ACTUAL B.T.U. FOR ONE CENT.

1908-1909. Increase. per cent.	Decrease. per cent.	1909-1910. Increase. per cent.	Decrease. per cent.	1910-1911. Increase. per cent.	Decrease. per cent.	Total Period Increase, per cent.
5.97	....	11.33	....	....	4.91	12.12
12.11	....	10.33	....	....	1.84	21.44
13.52	....	10.33	....	....	3.30	21.17
14.75	....	1.12	....	5.26	....	22.40
.....	....	4.65	....	7.98	....	13.02
.....	1.63	2.88	....	2.54	....	2.66
.....	....	.71	....	14.75	....	15.58
.....	....	1.64	....	8.47	....	10.25
.....	2.75	19.98	....	....	13.68	.74

ACCOUNTING AND COST-KEEPING SYSTEM OF THE UNITED STATES NAVY.

By J. Mendenhall, C. P. A.

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In Professor Hollis's valuable discussion of Secretary Meyer's organization of the United States Navy for higher efficiency, published in THE ENGINEERING MAGAZINE for February last, reference was made to the collateral betterment of the system for keeping the accounts of the navy yards and the Department. We are glad to present now what we promised a month ago—an authoritative description of the accounting and cost-keeping system of the United States Navy. Mr. Mendenhall is a member of the firm of Maverick, Mitchell & Co., by whom the system was devised and installed.—THE EDITORS.

ACCOUNTING and cost keeping for the Navy differs from that in other departments of the Government, and is more complicated than that of the average industrial establishment. There are several reasons for this, but the principal ones are that there must be a distinct line drawn between expenditures of a military nature and those of an industrial nature, and that each item must be charged to its proper appropriation as defined by law. The expenditures applicable to the quarters for the commandant and other officers attached to the yard, the marine barracks and quarters, the dispensary, the naval prisons, the guard houses, etc., are considered of a military nature and must be charged direct to the appropriations concerned; on the other hand, there are many expenditures applicable to the industrial part of the yard which cannot, under the law, be included as overhead or indirect expenses in the cost of productive work, as appropriations are specifically made for them by Congress. These latter consist of such items as salaries of officers, salaries of the clerical force, draftsmen, civilian assistants, sub-inspectors, expert aides, chemists, watchmen, messengers, etc., the principal part of which, in an industrial establishment, would be charged in the cost of work, through the medium of indirect expense.

It is evident, therefore, that when devising an accounting and cost-keeping system for the Navy it is essential to have a thorough knowledge of the laws governing appropriation expenditures and of the regulations of the Department. It is evident, also, that a cost system devised to take care of these special conditions will not afford proper comparisons with the results obtained by the cost system of an industrial concern engaged in similar work, namely, that of ship-

builders or engineers. At the same time, any system installed in the Navy should be such as will permit the chiefs of the bureaus in Washington, and the officers in charge of the work at the navy yards, to keep in close touch with the material and labor expenditures and the overhead expenses incident thereto.

In accordance with instructions from the Hon. George von L. Meyer, Secretary of the Navy, there has been installed a uniform system of accounting and cost-keeping in the Portsmouth, Boston, New York, Philadelphia, Norfolk, Charleston, Mare Island and Puget Sound Navy Yards. There has also been installed a more modern system of bookkeeping in the Bureau of Supplies and Accounts at Washington, where the complete financial transactions of the naval establishment are assembled and recorded.

Before attempting to describe the new system, it is advisable to outline briefly the organization of the Navy Department at Washington. The Department is administered by the Secretary of the Navy, who has, as his assistant, the Assistant Secretary of the Navy, and in addition four aides who act as personal advisors for the work of the divisions of Operation, Personnel, Material, and Inspection. In addition to these aides, the work of the Department is carried on by seven bureaus, as follows: Yards and Docks, Navigation, Ordnance, Construction and Repair, Steam Machinery, Supplies and Accounts, Medicine and Surgery, and the Headquarters of the Marine Corps. The work of each of these bureaus is under the immediate control of an officer appointed by the President, and confirmed by the Senate. These officers are responsible for the expenditures made against the appropriations under the cognizance of their respective bureaus. From the amount appropriated annually by Congress the respective Chiefs of Bureaus at Washington make monthly allotments to be expended at each navy yard or station. The amounts of these allotments are based on the expenditures made during the previous months and on requests for funds for work to be done under each appropriation, by the commandant or manager of a yard or station. They cannot be exceeded by yard commandants without first obtaining authority from Washington.

Navy-Yard Organization.

The organization of the navy yards is as follows: The commandant or general manager; the captain of the yard, who acts as aide or executive to the commandant and is also in charge of the yards and docks department, the manufacturing department, the inspection department, the general storekeeper's department, the pay department, the accounting department, and the medical department.

The manufacturing department is divided into two divisions, namely, hull and machinery. The hull division is in charge of the senior naval constructor on duty at the yard, who is directly responsible to the commandant or manager for the operation and work of this division. The following shops have been assigned to the hull division:

Saw mill	Blacksmith (hull)
Ship wrights	Plumbers
Spar	Upholstering
Boat	Galvanizing
Mold loft	Ship fitters
Block	Sheet metal
Joiner	Paint
Sail loft	Rigging loft
Rope walk	Anchor and chain

The machinery division is in charge of the senior line officer detailed for engineering duty, with a responsibility to the commandant or manager similar to that of the officer in charge of the hull division The following shops have been assigned to the machinery division:

Blacksmith (machinery)	Machine
Boiler	Pipe fitters
Coppersmith	Tool makers
Instrument makers	Electrical
Foundries	Pattern
Ordnance	

Function of Accounting Department.

The accounting department is in charge of an officer of the pay corps, and is under the direct supervision of the commandant or manager. The accounting officer has full charge of all accounting matters and cost-keeping records, the preparation of all reports of expenditures and statements of operating expenses, as well as the preparation of the yard pay roll. For convenience in handling the work, the accounting office at each yard is divided into several sections as follows:

Time	Appropriation
Material	Correspondence
Posting	

Job orders are issued by the officer in charge of the hull and machinery divisions for all manufacturing, repair, or productive work, and a copy is forwarded to the accounting officer. These job orders are so prepared that they become folios in a loose-leaf binder on which the accounting office makes the charges incurred in carrying out the work. Each job order is consecutively numbered, the job-order system being such that the number will show the appropriation,

the number of the ship or account to be charged, the division issuing the order, the serial number, and the title. This is important, because the cost of work must be recorded by appropriations, by ships, and by the title of the work. These job orders show a complete specification of the work required, as well as an estimated cost of the work. Where practicable to do so, these estimates are divided between labor, indirect expense, and material, and also by shops through which the work must pass.

Time and Material Records.

The time is reported daily, by each workman, in the form of an individual time ticket which embraces the labor performed by each man on a specific job. Separate time tickets are used when more than one job is worked upon during the day. The tickets are approved by the foreman, leadingman, or quarterman, and are forwarded early the following morning to the time section of the accounting department, where they are calculated and proved for each shop on a revised form of pay roll. Daily, they are also balanced with the total wages computed according to the number of employees in the yard, thus keeping an accurate account of the labor expended.

The advantage of this revised form of pay roll was demonstrated at the Boston Navy Yard, when an order was received from the Navy Department on December 22, 1909, authorizing the payment of the employees before Christmas. The pay roll, having been compiled and balanced daily, permitted the making of the official roll for the paymaster of the yard in the half of one working day. This would have been quite impossible under the previous system of handling the pay roll.

After the tickets are sorted to jobs, by means of job-order numbers, they are forwarded to the posting section, where they are posted daily, to the respective job orders, by shops. These job orders are of two classes, those under appropriations and those under shop, power plant and general expense, known as "Indirect Expenses." After being posted, the time tickets are passed to the appropriation section, where they are charged in totals to the appropriations and to the shop, power-plant, and general expense accounts, after which the postings made to the various job orders by the posting section are balanced with the postings made to each appropriation and to the expense accounts. From the above, it will be seen that the total daily pay roll is balanced with the total of the postings made to the various job orders and appropriations. Thus, the accuracy of the work is beyond question.

Material issued to the shops is handled in exactly the same man-

ner as the labor. All material is issued by the general storekeeper on the authority of properly approved stub requisitions. After these requisitions are priced and extended by the general storekeeper, they are forwarded to the accounting office, where they are charged to the proper job orders and to the appropriations or expense accounts, the total charges being balanced daily with the storekeeper's record of issues.

Indirect or Overhead Expenses.

The indirect or overhead expenses are classified under three headings: Shop Expenses, Power-Plant Expenses, and General Expenses.

The cost of operating each shop in each division is kept separate, and all expenditures incurred for labor and material are located daily to the following accounts:

Supervision
Maintenance of Equipment
Maintenance of Furniture and Fixtures
Maintenance of Loose and Hand Tools
Maintenance of Machine Tools
Maintenance of Buildings
Maintenance of Elevators
Miscellaneous Shop Expense
Power (Independent Plants)
Fuel

Statements are prepared and submitted monthly to the heads of divisions, showing the expenditures incurred, for each shop in their division, during the month on each of these accounts, as well as the previous month's expenditures, the increase or decrease in the current month as compared with the previous month, and the accumulated charges for the fiscal year to date.

The cost of operating the central power plant is kept under a separate group of accounts, and the expenditures for both labor and material are located daily as follows:

Maintenance of Power Plant Buildings
Maintenance of Sub-station Buildings
Maintenance of Power Plant Boilers, Flues and Stacks
Maintenance of Power Plant Piping
Maintenance of Power Plant Machinery
Maintenance of Distributing System—Heat
Maintenance of Distributing System—Electric
Maintenance of Distributing System—Pneumatic
Maintenance of Distributing System—Hydraulic
Maintenance of Water System
Maintenance of Sub-station Motors and Accessories
Maintenance of Tools, Furniture and Fixtures
Fuel
Power Plant Supplies
Oils, Grease and Waste
Attendants on Light and Power Plant
Supervision

A statement is prepared monthly and reported to the head of the machinery division showing, separately, the total labor and material expenditures on each of the above accounts for the current month, the total of each account for the previous month, and the increase or decrease in each account for the current month, as compared with the previous month, and also the total expenditures for the fiscal year to date.

Power is distributed to shop expense in each shop on the basis of meter readings for electricity, water and pneumatic power; heat is distributed on the basis of the cubical contents of the buildings, taking into consideration the nature of the building and the kind of work performed therein, or the purpose for which it is used.

In addition to the above mentioned classifications, there are many miscellaneous expenditures which cannot be located to a specific shop. These are separately accounted for under the heading of "General Expense," the expenditures for labor and material being located daily to the following accounts:

Maintenance of Miscellaneous Buildings
Maintenance of Elevators
Maintenance of Furniture and Fixtures
Maintenance of Telephone System
Maintenance of Roads, Walks and Gutters
Maintenance of Sewer System
Maintenance of Tracks
Maintenance of Railroad Rolling Stock
Maintenance of Weighing Apparatus
Maintenance of Hoisting Apparatus
Maintenance of Floating Property
Maintenance of Live Stock
Maintenance of Vehicles
Handling Materials, (not chargeable to Specific Shops)
General Office Expense, Accounting Department
General Office Expense, Hull Division
General Office Expense, Machinery Division
General Office Expense, Inspectors' Department
General Office Expense, Yards and Docks Department
General Office Expense, Yard Pay Office
General Office Expense, Labor Board
Drafting Room Expense, Hull Division
Drafting Room Expense, Machinery Division
Drafting Room Expense, Yards and Docks Department
Inspector's Department Expense
Testing and Inspecting
Maintenance of Testing Laboratories
Examination of Apprentices

A similar monthly statement is submitted to the heads of divisions showing the total labor and material expenditures charged to each of

the above accounts, the total charged to each for the previous month, the increase or decrease in each account for the current month, as compared with the previous month, and the total expenditures for the fiscal year to date.

General expense is added to shop expense in each shop on the basis of productive labor performed therein.

The indirect charges applicable to each shop, therefore, consist of (1) its direct shop expense, (2) its proportional part of the power-plant expenses and (3) its proportion of general expense.

The statements for the operating or indirect expense at each yard are in the hands of the officers concerned from the third to the sixth of the month following that in which the expenditures were incurred. Previous to the introduction of this system, the officers in charge of the divisions of the yard were not in possession of any of this information, nor were the accounts kept in such a manner as would show the cost of operating individual shops, nor as to how the operating expenses of these shops compared with the productive labor performed therein. It was, therefore, utterly impossible to expect economies to be effected in operating the shops in the various yards. Since these statements have been furnished to the officers, it is a well-known fact that the operating expenses in many of the yards have been reduced.

Application of Indirect Charges to Cost of Work.

The indirect charges are applied to the productive work of the yard on a percentage basis, depending on the shops through which the work passes. The percentage for each shop is obtained by dividing the shop expense by the productive labor performed therein. This percentage is then applied to the productive labor performed by each shop, thus giving the indirect charge to be located against the job. For example: Suppose a job is done at the New York Navy Yard, requiring the work of the riggers, ship fitters and joiners; assume that the percentage to be used for the riggers' shop is 20 per cent, that for the ship fitters 30 per cent, and that for the joiners 45 per cent; and that the productive labor and material consumed by each of these shops are as follows:

	Labor.	Material.
Riggers	$10.00	$50.00
Ship Fitters	70.00	30.00
Joiners	100.00	150.00

By applying the above percentages to the labor performed in each shop, the total cost of the order would be:

	Labor.	Indirect Expense.	Material.	Total.
Riggers	$10.00	$2.00	$50.00	$62.00
Ship Fitters.....	70.00	21.00	30.00	121.00
Joiners	100.00	45.00	150.00	295.00
Total Cost.....	$180.00	$68.00	$230.00	$478.00

There are several methods of absorbing the indirect expense over the cost of work, such as the machine-tool rate, hand-labor rate, hourly burden, etc., depending on the conditions requiring their use, all of which are correct, but the method of absorbing the indirect expense over the cost of work on the basis of productive labor, as herein described, is believed to be sufficiently accurate—especially so when it is taken into consideration that this method is in operation in some of the largest and most successful industrial manufacturing establishments in the United States, and that it requires considerably less clerical work to operate it than most other methods.

Items Not Included in Indirect Expense.

As previously stated, in devising this system it was not the intention that the indirect expense applied to the cost of work should include all the charges properly applicable thereto so that the cost could be compared with that in similar industrial establishments. To include all such charges would be a direct violation of the law governing appropriation expenditures, and it is therefore impossible to obtain all the results desired until such time as Congress amends the laws accordingly. Among the items which are not included in the direct expense and are therefore not applied to the cost of productive work, are, as already mentioned, the salaries of officers, these being chargeable to the appropriation "Pay of the Navy." For the wages of the clerical force, draftsmen, civilian assistants, sub-inspectors, expert aides, chemists, watchmen and messengers, Congress has specifically appropriated amounts under the various main appropriations; and in the appointment of these employees, the appropriation from which they are to be paid is designated by the Department. Furthermore, the Attorney General in his decision of February 28, 1910, has, by implication, decided that these payments should be located against the proper appropriations.

All navy-yard employees receive pay for seven national holidays; laborers and mechanics are allowed fifteen days' leave with pay after one year's service, but no sick leave; per diem classified employees (clerks, draftsmen, inspectors, messengers, etc.) are allowed fifteen days' leave, and, in exceptional and meritorious cases, can be granted

fifteen additional days on account of sickness; per annum classified employees at navy yards are allowed thirty days' leave, and, in exceptional and meritorious cases, can be granted thirty days additional on account of sickness; by executive order, four hours (exclusive of time for luncheon) constitutes a day's work on Saturdays, during the months of July, August and September, for all clerks and other employees of the Federal Government wherever employed, with the proviso that the order shall not apply to any bureau or office of the Government, or to any of the clerks or other employees thereof, that may for special public reasons be excepted therefrom by the head of the Department having supervision or control of such bureau or office, or where the same would be inconsistent with the provisions of the existing law.

It will be seen therefore that all per diem employees of the navy yards are entitled to twenty-seven days' leave and holiday per annum. As no such conditions exist in commercial establishments, it would be inconsistent to charge these expenditures to the cost of productive work.

In addition to the above, unclassified employees are paid full pay if injured in the line of duty, while engaged on Government work, and if killed, their heirs are paid one year's salary at the per diem rate the employee was receiving at the time of his death.

The cost of this leave, holiday and disability is not included in the indirect expense, but is charged daily directly to "Increase of the Navy" appropriations and the main appropriation of each bureau on the basis of productive labor performed.

The expenses of receiving, testing and handling stores purchased under the Naval Supply Account, must be charged against the appropriation "Provisions, Navy" in accordance with the decision of the Attorney General under date of February 28, 1910. While we appreciate the fact that storekeeping expense is properly charged to indirect expense, this is not permissible in the navy system, owing to the above decision. A classification of accounts has been established, however, to record all storekeeping expenditures, and should a law be passed authorizing their inclusion in the indirect expenses, it will not necessitate any change in accounts or addition of new accounts to the system. It may be mentioned, however, in this connection, that a large proportion of storekeeping expense is of a military nature, such as the issuing of supplies, provisions, coal, oil, etc., to ships in commission and, therefore, a division would have to be made between military and industrial.

Fire-insurance premiums and depreciation on property and plant are also not included in the cost of work, as these items have been declared to be illegal by the Attorney General in his decision of the above date. Interest on money invested also is not taken into consideration. Nor is there any allowance made for taxes on the property owned by the Government and occupied as navy yards.

To have fire-insurance premiums and depreciation included in the cost of work would necessitate that Congress provide a law making this procedure legal. Expenditures for replacements of buildings or other property are now paid for from specific appropriations. Expenditures for replacement of machine tools and shop or yard equipment are now charged to the appropriation concerned, under the bureau authorizing the expenditure. In order to determine what charges shall constitute replacements, a limit of $100 has been placed upon certain expenditures chargeable to the classification of accounts under shop, power, and general expenses—that is, if a repair job on a machine tool, building, or other equipment is estimated to cost $100 or more, the officer in charge has instructions to issue a special job order, charging the cost of this order to the appropriation under which the expenditure was authorized.

It has been stated that by setting this limit of $100 the officers in charge of the different shops may evade paying for expenditures from their appropriation, by splitting the work over several jobs and charging it to shop expense. Should this be the case, the officer in charge of the work, who approves the job order, would be violating the regulations. By doing so, he would also be increasing his shop percentage, and it necessarily follows that such a procedure would be detrimental to the economical operation of his shop. By comparing the increases or decreases as shown in the shop percentage statements previously described, the manager of the yard can immediately discover any appreciable increase, and hold the officer in charge strictly to account.

Reports on Work in Progress.

At some of the yards the officers in charge of the work have requested that they be advised daily of the total labor, indirect expense and material charged to each job order under jurisdiction. Objections have been raised, however, to furnishing them this information, as it provides the foreman, leadingman, or quarterman, in charge of the work in each shop, a means of diverting charges from one order to another, so that their work may compare favorably with the estimates; and because, to supply this information, it would be neces-

sary to increase the clerical force of the accounting department to such an extent that the expenditure would be entirely out of proportion to the results obtained. Such a practice is also not in accordance with the regulations observed in well managed industrial concerns.

When the expenditures on a job order are within 70 per cent of the estimated cost, the accounting officer informs the heads of the divisions to that effect. This enables the officer in charge of the work to investigate its progress, and if the work is not within 70 per cent of completion, to ascertain the cause for the over-expenditure. The cost of work records kept by the accounting officer are at all times open to the inspection of the officers in charge of the work, so that they can keep in close touch, and compare the expenditures with the progress of their work.

Upon completion of each job order, a notice is sent to the inspection officer, who, after inspecting the work, notifies the accounting officer of its completion. A report is then made out which shows the job-order number, the ship or heading, the specification, the estimated cost, and the actual costs, by shops, divided between labor, indirect expense and material. These reports are forwarded without delay to the heads of divisions at the yards, and to the bureau concerned, at Washington. This permits the latter to make a careful scrutiny of the charges shortly after a job is completed, and enables them to correspond immediately with the yard in cases where it is necessary.

Prior to the introduction of this system, no such detailed reports were available, either for the use of the officers of the yards or for the use of the chiefs of the bureaus concerned at Washington.

At each navy yard there are from two- to five-thousand active job orders at all times. From this number of active job orders one can readily appreciate the amount of clerical work involved.

In order that the officers in charge of the work, and the manager of the yard, may be informed daily of the expenditures made against each appropriation, the accounting officer, after balancing the appropriation charges for labor and material drawn from stores as already described, prepares a report showing the amount allotted from each appropriation for the month, divided between labor and material, the daily expenditures and the amount expended to date, as well as the available balance. These reports are made, in most cases, within from twelve to fourteen working hours after the expenditure has been incurred, and inasmuch as they are balanced with labor and material records, it necessarily follows that they are correct. Therefore, the officers in charge of the work are kept well informed of

costs and expenditures, and they are certainly given the opportunity of becoming more familiar with the cost of their work than the average superintendent or manager of an industrial establishment.

Monthly Report of Expenditures.

At the close of each month the accounting officer prepares a report which shows the expenditures, separately, for labor, material, and indirect expense for each appropriation under which work was performed. This report is in such detail that it affords each bureau the information necessary for the proper management of the work under its control and also permits the recording of expenditures such as is required for the preparation of the annual report of the Paymaster General.

In this connection it is necessary to explain that navy expenditures are made under a system of headings which are standard throughout the service. First, there is a system of titles which represent various classes of expenditures. These titles are represented by capital letters of the alphabet. For example: Title "D" represents Repairs to Ships, Title "E" represents Real Estate and Chattels, Title "F" Machinery Plant, and Title "G" General Maintenance, etc. In establishing the accounting system, it was found necessary to increase the headings under several of these titles, in order to classify the expenditures more clearly. In preparing the various periodical reports required, the expenditures are arranged first by titles and then by standard headings under titles. For example: In the case of Ships' Repair Work, there are three main headings with ten sub-headings under each of these main headings. The expenditures also have to be shown under each ship. The report of expenditures in the case of Ships' Repair Work, would read therefore as follows: Title "D," meaning Repairs to Ships, the name of the ship, the main headings, namely, Wear and Maintenance, Changes and Additions, or Casualties; with the sub-heading, such as Boilers, Engines, Hull and Fittings, Auxiliary Machinery, Wireless Telegraphy, etc. Likewise, work performed under Title "E," Real Estate and Chattels, would show the title, then the standard heading, such as Railroad Rolling Stock, Hoisting Apparatus, Yard Equipment, Buildings, etc.

At the end of each month, the total expenditures for all appropriations are balanced with the grand total of the pay roll and with the value of material issued by the general storekeeper. This is done because expenditures must be reported to the Treasury under the headings of labor and material only; consequently, the indirect expense must be divided between labor and material. This is accom-

plished by dividing between labor and material the total indirect expense charged to each appropriation, in the same proportions in which labor and material exist in the total indirect expenses of the yard. These expenditures are, however, recorded in the Bureau of Supplies and Accounts at Washington, so as to show, separately, under each appropriation, the labor, material and indirect expense, in accordance with the law.

These reports are forwarded to all bureaus having cognizance of the various appropriations involved, in from five to ten working days after the close of the month. Under the previous system, it required from twelve to twenty-five working days for the preparation of the reports, and even then they were compiled in less detail than those now furnished.

Books of Accounts.

To perfect the cost-keeping system at the navy yards, and to carry it to a logical conclusion, it was necessary to introduce a complete double-entry bookkeeping system of accounting. This system is arranged to provide for the recording of all property and plant accounts at each yard. There are but three books used, namely, a general ledger, a subsidiary ledger, and a journal. The general ledger contains the various controlling accounts for Property and Plant, Work in Progress, and Operating Expenses, while the subsidiary ledger contains the details of the property and plant and the operating-expense accounts. Entries for the ledgers are made, monthly, from the cost of work records by journal vouchers, and the ledger accounts are intended to show, monthly, the total value of the work in progress and of completed work, the total operating expenses, appropriation charges, pay rolls and materials consumed. A trial balance of each ledger is prepared monthly and forwarded to the Bureau of Supplies and Accounts.

Naval Supply Account.

Prior to April, 1910, the manufacture and repair of articles for stock at navy yards and the purchasing of large quantities of naval supplies was conducted through the medium of the Naval Supply Fund, a fund created by Acts of Congress, with an authorized limit of $2,700,000.

In February, 1910, the Secretary of the Navy asked for the opinion of the Attorney General in regard to the legality of the manner of conducting the affairs of this fund. The fund had increased so that its worth on March 31, 1910, was approximately eleven and a

half millions. This increase was due to several causes, but principally to the consolidating, under it, of what was technically known as "Common General Stock," namely, stock bought under annual appropriations of previous years and held for use but not chargeable against an appropriation when drawn from store.

The Attorney General on February 28, 1910, decided that the method of operating the Naval Supply Fund was not sanctioned by law. It therefore became necessary to return to Common General Stock a portion of the stores in the fund, and to obtain an Act of Congress that would permit the purchase of stock or expenditures for manufacture and repair of articles for stock for the naval establishment, under one fund or account. The following legislation was therefore obtained:

> All stores on hand July first, nineteen hundred and ten, shall be charged to a naval supply account on the records of the Bureau of Supplies and Accounts, and all purchases of stock or expenditures for manufactured or repaired articles for stock at navy yards or stations, during the fiscal year nineteen hundred and eleven, and nineteen hundred and twelve, shall be charged to this account and be paid for from "General Account of Advances."
>
> The amount so advanced during the fiscal years nineteen hundred and eleven and nineteen hundred and twelve shall be charged to the proper appropriations as these stores are consumed from stock, and when disbursements made for all other purposes are accomplished, the amount so charged shall be returned to "General Account of Advances" by pay or counter warrants; PROVIDED, however, That such material as provisions, clothing and small stores, medical stores, and such other materials as the Secretary of the Navy may designate, may be purchased by specific appropriations or transferred to specific appropriations before such materials are issued for use or consumption. The said charge, however, to any particular appropriation shall be limited to the amount appropriated therefor.
>
> Credit shall be made to appropriations during said fiscal years nineteen hundred and eleven and nineteen hundred and twelve for the value of surveyed material taken from repairs made to Ships or Plant at navy yards and stations, or for stores turned in from ships, and this credit shall not be used by the Bureaus to increase the amount of that appropriation, but shall be a deduction from the operating expenses of the annual appropriation concerned, subject to the same provision as stated in above paragraph.—Deficiency Act, June 25, 1910.

The advantages of purchasing supplies for the navy under one account are obvious, as it places the matter on a business basis. Under the system of "Common General Stock," the various bureaus were in the habit of making requisitions for quantities of supplies of the same kind and character. The general storekeepers were required to submit such requisitions under each bureau appropriation, and the supplies had to be contracted for, stored and accounted for,

separately. The quantities required were comparatively small, and consequently higher prices had to be paid than would have been the case if larger quantities could have been purchased. It is a well founded business principle that in order to obtain the cheapest prices, the invitation to bid should be as attractive to the manufacturer as possible, and large quantities should be bought when it is safe and practicable to do so.

Further, by the establishment of this one account, known as the Naval Supply Account, the method of keeping accounts, both for stores purchased, manufactured or repaired, is greatly simplified; clerical labor is reduced, economy in both time and money is obtained.

It should be remembered that the Navy must be ready for duty at all times and that it has many outlying stations throughout the world; therefore, it is required to maintain a large stock of supplies in order to meet emergencies. By the operation of the Naval Supply Account, it has been possible, by the consolidation of stores, to reduce the actual quantities carried and at the same time fulfill the above mentioned requirements of the service.

In consequence of the passage of the act establishing a Naval Supply Account, and the system of accounting in navy yards, a radical change was made necessary in the bookkeeping of the Navy Department. A system has been devised, founded on the most modern bookkeeping practice. It will enable the Bureau of Supplies and Accounts to furnish the Department, or any of its bureaus, information desired regarding the expenditure of funds chargeable to the various appropriations, both as to direct and indirect charges, and the value of material or stores consumed. The system will also establish a set of personal accounts with every disbursing officer under the Navy Department, and will show the value of stores on hand at the various yards, under the accounts established, and the increase or decrease of such stores. These improved methods will enable proper debit and credit entries to be made, both as regards material and money; thus a reliable double-entry bookkeeping system that will permit of the taking of a proper monthly trial balance is established for the first time in the history of the Navy.

Before establishing this system, which, it might be well to add, is based on the special needs of this branch of the Government, it was necessary to consult the accounting officers of the Treasury, and so arrange the naval accounts as to accord more directly with the books of that Department. This will in all probability result not only in prompt adjustment of appropriation charges, but in more expeditious, and therefore in more satisfactory settlement of naval officers' accounts.

RECENT MECHANICAL IMPROVEMENTS IN THE MANUFACTURE OF ILLUMINATING GAS.

By Jacques Boyer.

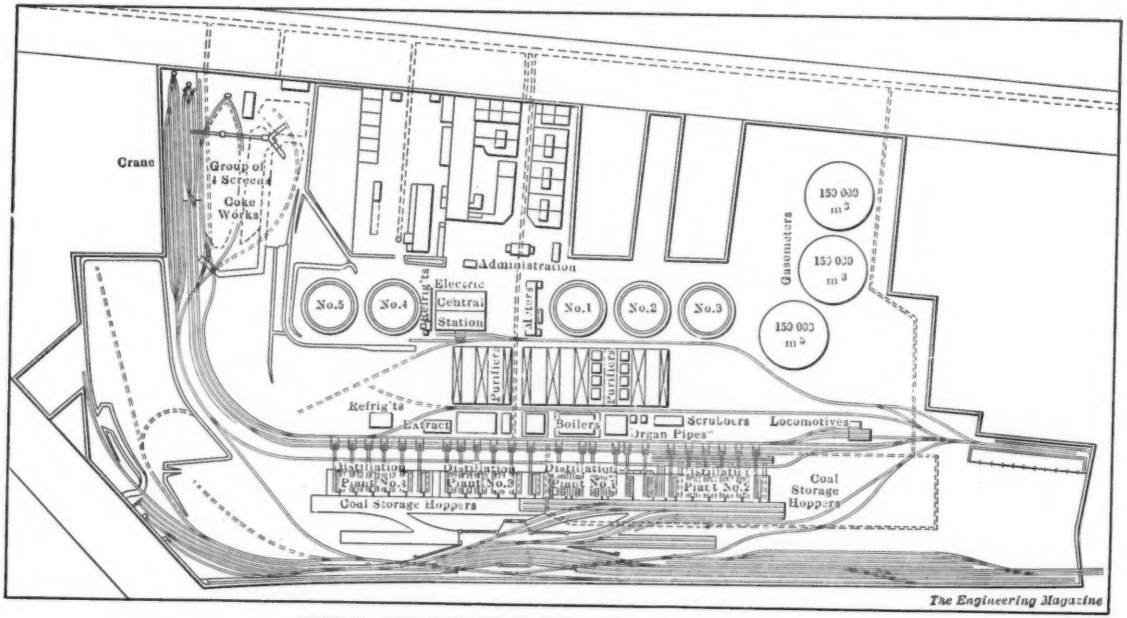
The article following is interesting not only of itself, but as a supplement to the preceding series by Mr. Rollin W. Hutchinson, Jr., in which the rapid advance of electric illumination was summarized. Professor Boyer shows, in contrast, the corresponding progress made in the manufacture of illuminating gas—a progress resulting partly from the reflex or competitive influence of the development of electricity, and characteristically illustrative of the constant widening of the field occupied by the mechanical engineer.—THE EDITORS.

RAPID increase in the population of Paris during recent years has been followed by a corresponding increase in the use of gas, which in turn is favorable to reduction of costs; thus, from 1902 to 1909 the number of consumers grew from 454,651 to 631,127, and the cubic metres of gas consumed passed from 303,000,000 to 429,000,000. If the same rate of growth continues, illumination and heating by means of gas will require about 550,000,000 cubic metres in 1920.

To respond to such demands it has been necessary to increase the productive capacity of the Landy works, to improve the apparatus in the works at Clichy and La Villette, and to provide for the early replacement of six out-of-date plants, situated within the city, by the huge Cornillon plant, which installation is built on an area opposite the Landy works, and by another plant situated in the southwest part of Paris.

As a beginning, the municipal administration proceeded to buy up the old and new "Compagnie Parisienne d'Eclairage et de Chauffage par le Gas," whose concession dating from 1855 expired December 31, 1905, though it continued operation under provisional charter up to August 31, 1907. Its equipment was turned over under certain conditions to the new Société du Gaz de Paris, which now administers the monopoly in the interest of the city.

Paris, desiring to maintain her old reputation as *la Ville Lumière*, is appropriating 180,000,000 francs for the reorganization of this service. To the north of the city will be built the new Cornillon works occupying an area of 46 hectares, and producing at the outset 350,000 cubic metres, which will be gradually increased to 700,000 metres.



GENERAL ARRANGEMENT OF THE LANDY GAS WORKS, PARIS.

For the present, the Landy works have been trebled by the installation there of three new sections, which, when finished, will enable it to supply 700,000 cubic metres per twenty-four hours. The horizontal retorts at La Villette will be replaced by high-power inclined retorts. Finally, the plants at Passy, Vaugirard, Boulogne, Saint-Mandé, Alfortville, and Ivry will be dismantled because the manufacture of gas with the apparatus there installed is inordinately expensive, even when taking into account the fact that none of these esablishments has a railway connection and that the last two are far distant from the Seine, the cost of transporting coal being therefore excessive. The sum to be recovered by the city from the sale of the sites and the machinery at these plants is estimated at 20,000,000 francs.

Let us now review the Landy works, where the retorts require daily from 900 to 1,000 metric tons of coal, furnishing at present 300,000 cubic metres of gas. This output will soon be increased to 700,000 cubic metres, requiring 2,400 metric tons daily. The plant covers an area of 48 hectares north of Paris, near Saint Denis. The arrangement of the buildings is indicated on the plan, while the accompanying photographs show the most interesting of the novel mechanical appliances installed, to which further reference will be made in the description of the operation. The plan shows immediately that the various buildings and processes are arranged in parallel. At the entrance are seen the coal piles and chutes, then the distilling plant, followed by the purifying apparatus, and finally the gasometers and distributing arrangements. Coal is received at Landy from the north, from Great Britain or from Westphalia, either by canal or rail. The company owns its own railway wagons and ten locomotives. As a provision against mine strikes or suspension of railway or water traffic, coal is stored in the open air, in piles, or in covered silos and hopper storehouses in the front of the plant. The fuel passes directly from these hoppers to the retorts through a series of mechanical-handling appliances designed to eliminate the hand labor formerly so costly in this industry. The full railway wagons pass over an elevated track, where they are weighed. They are then discharged laterally into hoppers, or huge funnel-shaped bins placed below the track. An operator stationed in a controlling office directs the coal into the series of conveyors serving each battery. Descending first to crushers, it is automatically elevated to the top of the plant and distributed to towers near the retorts awaiting its distillation.

These transporters, which handle about 600 metric tons daily in each section of the plant, occupy a building parallel to the distillation

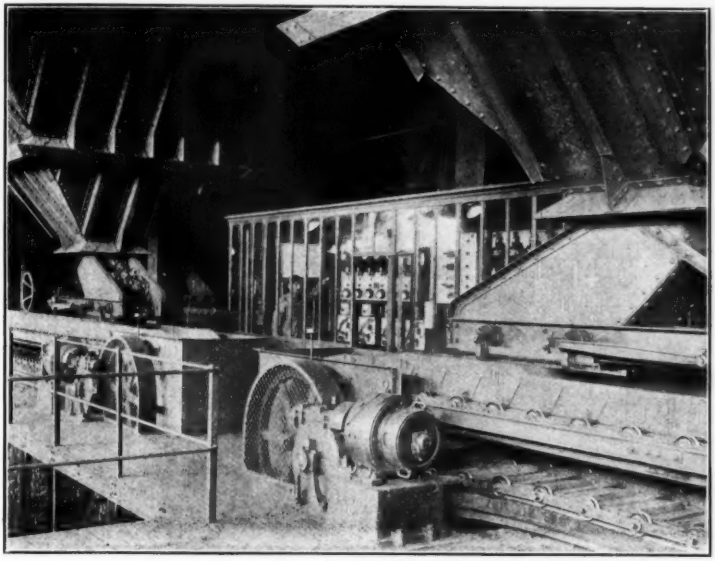
house and equal to it in length. Some of the conveyors handle lean coal and some rich coal. The two kinds are mixed in proportion regulated at will according to the speed of the conveyor and the quality of gas desired. Each section of the works has thirty-six hoppers, arranged in three parallel rows of twelve, above six conveyor lines running parallel to the longest dimension of the building. These conveyors or endless belts are electrically driven.

Discharging the hoppers is the only manual operation in this part of the plant. All other handling is mechanically accomplished. The coal as discharged falls upon the conveyor, while a distributor, with a backward and forward movement imparted by the endless chain of the conveyor itself, gives an alternating motion to the gate of the hopper, thus preventing the coal from wedging in the chute. The six longitudinal conveyors discharge the lumps into two similar transverse lines installed on a lower level. These latter carry the coal toward the distillation house and deliver it to the two jaw crushers, which reduce it to a suitable size. A Hunt chain bucket conveyor, running the length of the building, passes underneath the transverse conveyors and crushers, and raises the crushed coal from the basement of the works to the top, where the towers are placed in which the coal awaits transportation to the retort.

As each section of the distillation plant contains six batteries of six furnaces each, the six corresponding towers, placed in line underneath the upper part of the Hunt conveyor, must each receive regularly its hundred tons of coal, that being the quantity necessary for twenty-four hours' distillation. The operator discharges a tower very simply by electrically-operated devices, the entire control being centralized at an operating switchboard in the middle of the plant.

Let us now examine the four distillation houses, all alike, which compose the Landy works. Within the huge area of each are placed six batteries, ranged in parallel and surrounded by a free space serving for charging and emptying of the retorts. Each battery contains six furnaces of nine horizontal retorts each, six metres long, heated by gas from a Siemens coke-fed producer beneath

A battery force formerly was composed of two firemen, six chargers, six dischargers, and two coal passers who brought in the coal for the retorts. Finally, another workman, called ironically in technical slang the *"Mylord,"* cleaned up around the furnace, stopped leaks, and did any other necessary detail work. Three chargers were required to handle the *cuiller,* a semi-cylindrical scoop three metres in length. It was filled in advance with 75 kilogrammes of



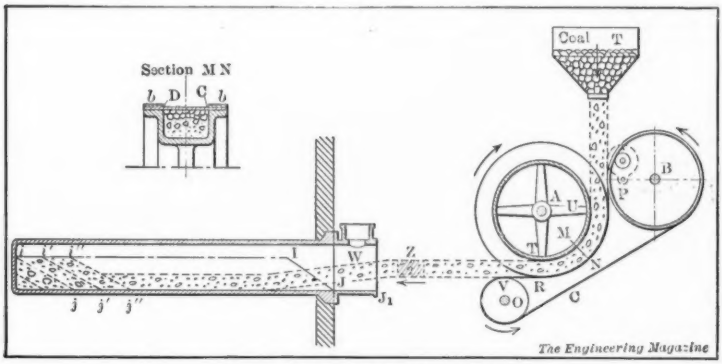
COKE CONVEYORS, AND OPERATOR'S CABIN.

coal (half a retort charge); when the coke produced from the preceding charge had been withdrawn from the retort by a discharger, two chargers raised the scoop by means of a cross-bar placed underneath, and a third seized the grip which terminated the handle of the instrument. Then all three advanced toward the retort and with mathematical precision charged the coal into it in the twinkling of an eye. The end workman would turn the handle at the precise moment to discharge the load which his two companions carried, and would dexterously turn the contents of the scoop into the retort, and in less time than it takes to write it, they would charge a second scoopful; the discharger would quickly close the door of the retort, and two or three turns of a screw sufficed to close it hermetically. They passed then to the next retort and in an hour and forty minutes the whole battery would be charged. At the end of four hours distillation was complete, and at the fireman's whistle charging was begun again.

The retorts must first be emptied. Each discharger, a red-hot iron in his hand, approached the retort under his care and lighted it, the orifice being very gently opened part way so as to avoid the explosion which would be caused by a sudden entrance of the air. This being done, the man opened wide the discharge door, and, without

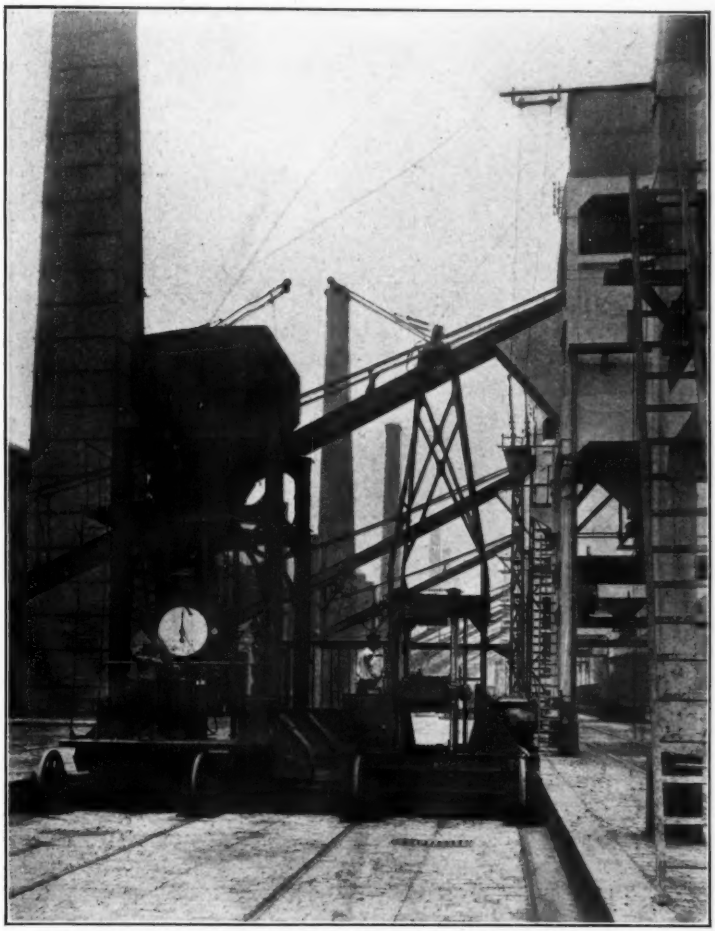
stopping, proceeded to the same operation on the next retort. At this moment a second discharger approached rolling a *marmite* (a heavy steel basket mounted on two wheels), into which he pulled with a long tool the 2½ hectolitres of coke constituting the first residue of distillation.

Nowadays, the task is much easier. At Landy the retorts are filled with the aid of Brouwer chargers, and are emptied by the Sautter-Harlé dischargers. A Brouwer chain carries away the quenched coke and delivers it into reinforced-concrete hoppers, whence it is taken in cars to the coke works.



BROUWER RETORT-CHARGING MACHINE

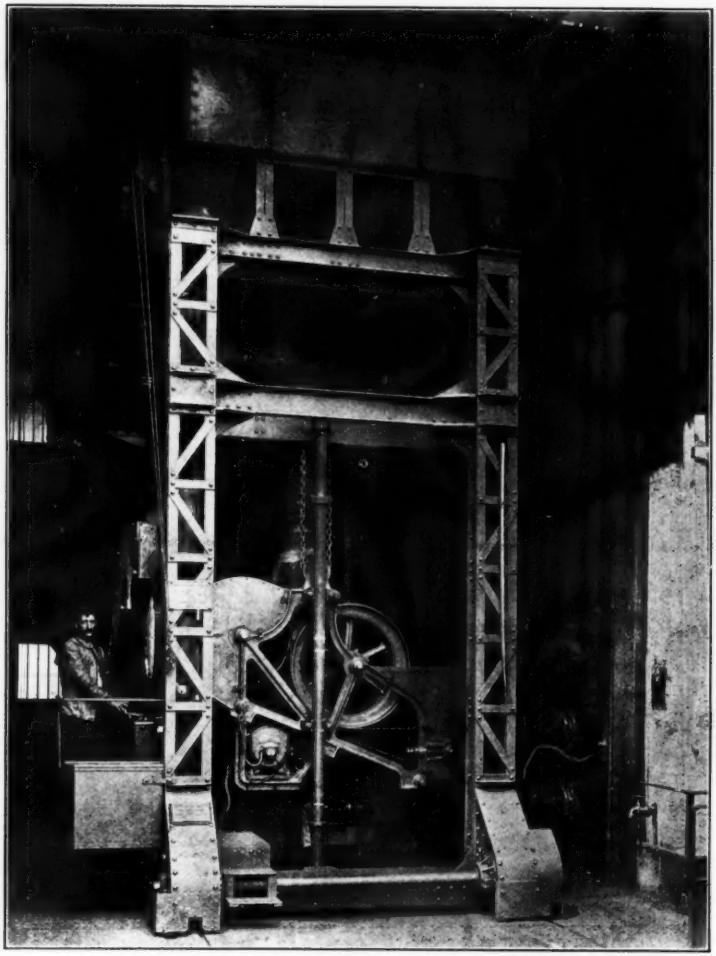
The principal part of the Brouwer charger is a groovel wheel (A, Figure 2), with a U-shaped rim; a leather belt engages one quarter of the circumference (R P), thus enclosing that portion of the hollow face of the wheel. Two strips bb, stitched along the edges, reinforce the borders of the belt. This endless belt C, passing first around the motor pulley B and thence around the driven pulley O, forms a U-shaped artificial canal around a quarter circumference of the charging wheel A. When this wheel is given a sufficient speed of rotation, the centrifugal force acting upon the coal descending from the hopper T, as this coal passes from P to R of the U-shaped channel, gives it a motion which is supplemented by the travel of the belt from R to V, from which point the coal is left to travel tangentially into the retort W. Applying the laws of ballistics, it will be seen that the stream of coal reaching the end of the retort will spread and the successive layers will take the position shown by the lines i j, i^1 j^1. Experience proves that as the charging of the retort is finished the front of the coal follows the profile I J, and as the space J J is left entirely free



ELECTRICALLY OPERATED RETORT-CHARGING AND DISCHARGING MACHINES.

from coal dust, the retort may be hermetically sealed by merely closing the plug.

The operating parts of the Brouwer charger are mounted between two standards of a thoroughly braced and well-poised steel structure. A starting rheostat in front of the operator controls the electric motor driving the charging machinery, stepped resistances giving the



AUTOMATIC CHARGING MACHINE FOR THE RETORTS.

necessary speed variations. The electrical features are designed in view of the weight and character of coal to be handled. The idler and driven pulleys run loose on hollow shafts, keyed to the framework of the charger, with internal lubrication; entrance of dust between the moving surfaces is thus avoided and the wear thereby reduced. A feed hopper fixed on the structure of the machine itself carries a

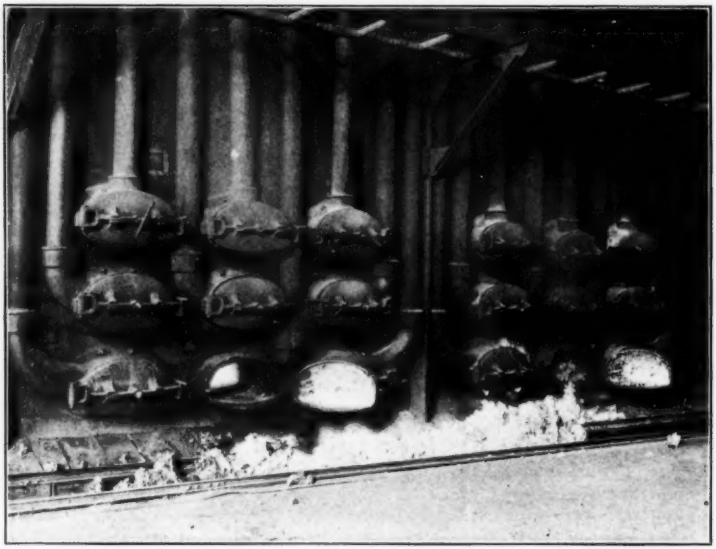
charge sufficient for nine retorts. At the foot of this feed hopper is a screw delivering the coal to the concave pulley. The number of turns of this screw, which is driven by an independent motor, determines the weight of each charge. The entire mechanism is supported on a rolling carriage moving along two rails parallel to the front of the retorts. For recoaling, the charger is run under one of the storage towers placed at the end of each of the battery furnaces.

When distillation is finished, the retorts are opened at both ends and the Sautter-Harlé discharger enters upon the scene. By the aid of a long ram, operated by rack and pinion (see page 935), the machine forces out the mass of coke in the retort, which falls, broken into pieces, onto a Brouwer conveyor at the other end.

The discharging ram is telescopic, consisting of three sections, and carries a flat head of section slightly less than that of the retort. Movement of the ram, and also the transverse movement of the whole machine, is effected by an electric motor of 12 horse power at 900 revolutions. The operator, standing on the rear platform, controls the transverse movement of the entire machine, the raising and lowering of the ram, and its movement of thrust and withdrawal. The first lever acts upon a friction coupling, which, through the intermediary of a worm-gearing, drives one of the axles of the machine. The charger moves to the right or to the left as the friction is thrown in on one side or the other. Raising and lowering of the ram is controlled by a lever acting upon another friction clutch, which engages one of the four vertical screws shown in the illustration, upon which the ram is supported by bronze nuts. The four screws are connected by a chain running over sprockets at the top so that they move in common, and the casing supporting the ram is lifted or lowered according as the driving screws revolve one way or another. The telescope movement of the ram itself follows the control of a friction cone driving a worm-gear, which revolves a slotted vertical shaft carried by the framework of the machine. To this shaft is keyed one of a pair of bevel gears, the mate to which, through a second pair of bevel gears, drives the five pinions which mesh with the rack of the ram. The pushing ram is in three sections, which come into play successively beginning with the innermost. This carries on its front end a piston, which drives the red-hot coke out of the retort.

The entire Sautter-Harlé discharger occupies a space of but 3.7 metres in width across the front of the furnaces. Its operation is entirely comfortable, since the mechanician is sheltered from the heat of the retorts and performs no labor beyond the manipulation of the

levers. After throwing the clutch lever he presses one of the buttons at his right hand. The racks and pinions engage, stop at the end of the run, reverse, and stop again without any intervention on his part except a simple pressure on the discharging button. The movement of elevation and transfer is accomplished the same way, while a safety switch secures absolute stop.



MECHANICAL EMPTYING OF RETORTS. DISCHARGE END.

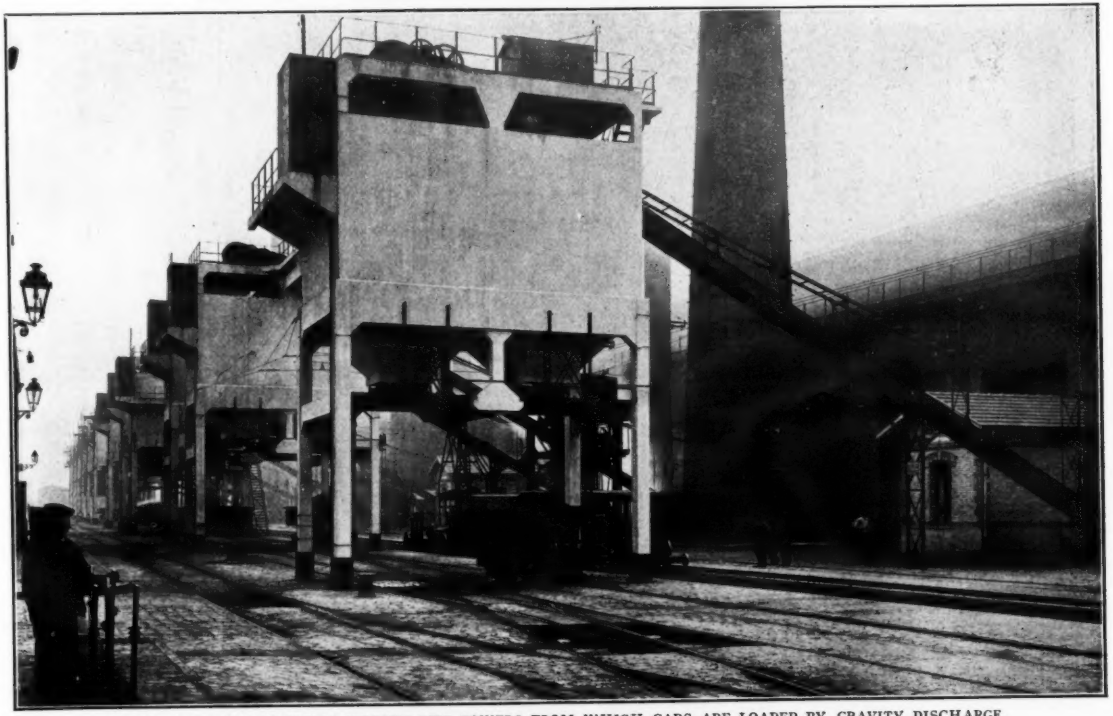
In the table below are presented a number of figures illustrating in detail the operations of the electric dischargers at the Landy works. The retorts are 6 metres in length, carrying a charge of 600 kilogrammes and requiring 8 hours for distillation. The operation of emptying the retort, including the placing of the machine, takes in the average 55 seconds; in other words, each discharger can empty about 65 retorts per hour. The speed per second of the various movements and the current consumption at 240 volts are as follows:

Operation.	Metres.	Kilowatts.
Discharging by the ram	0.36	1.80
Return of the ram	0.46	1.08
Raising the ram	0.22	1.80
Lowering the ram	0.23	0.72
Shifting the machine	0.60	1.20

SAUTTER-HARLÉ AUTOMATIC RETORT-DISCHARGING MACHINE.

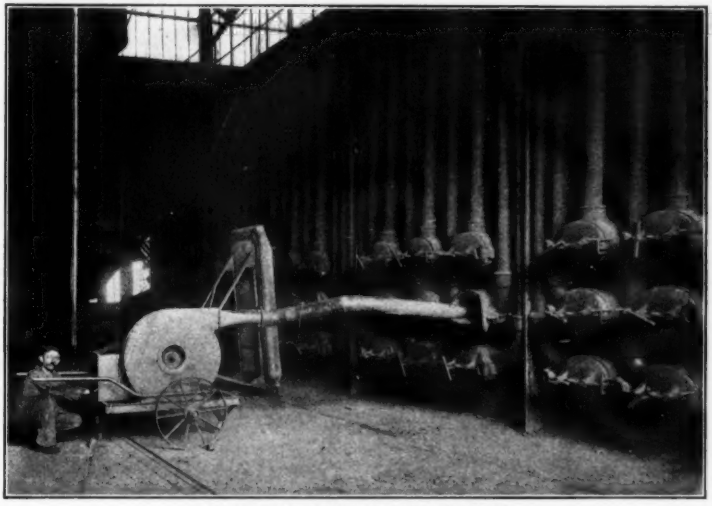
Diagrams secured by the aid of the registering apparatus show that the total consumption of energy under ordinary operation per retort discharged is only about 17 to 20 watt hours. Allowing 25 for errors of movement and for contingencies, it may be calculated that one kilowatt hour will suffice for 40 retorts containing 17 tons of coke, and yielding 7,200 cubic metres of gas approximately.

At the other end of the retort battery when machine discharging



AUTOMATIC COKE ELEVATORS FILLING THE TOWERS FROM WHICH CARS ARE LOADED BY GRAVITY DISCHARGE.

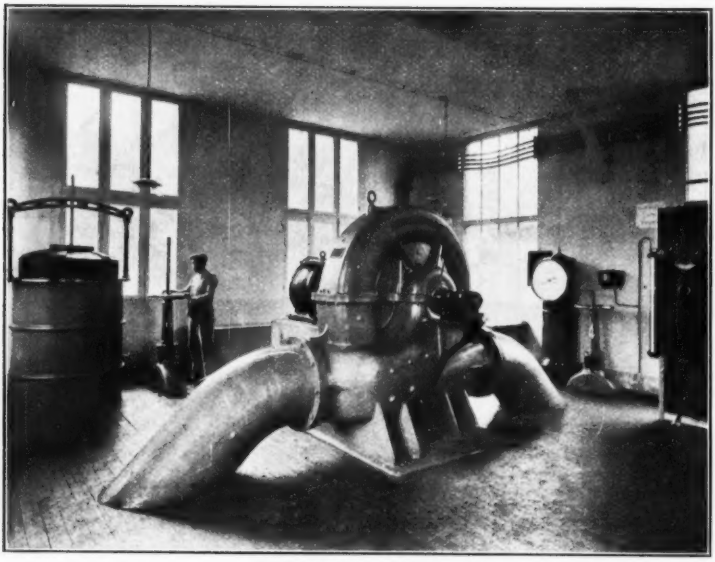
is going on there appears for several minutes a river of fire, of which the photograph gives a very faint idea. During this period the Brouwer conveyor carries the incandescent coke out of the building. At its exit, the coke is quenched by passing through a tank full of water, from which the resultant vapor escapes through large chimneys. Furthermore, the remaining jets of gas and of smoke are harmless, as the distilling house is deserted at the time of discharge. The only manual operations necessary are to open and close the heads of the retorts and sometimes to open with a sort of iron bar the riser through which the gas escapes. When the distillation is finished a workman also brings up a portable fan, which blows in a jet of air to burn up the graphite remaining in the retorts.



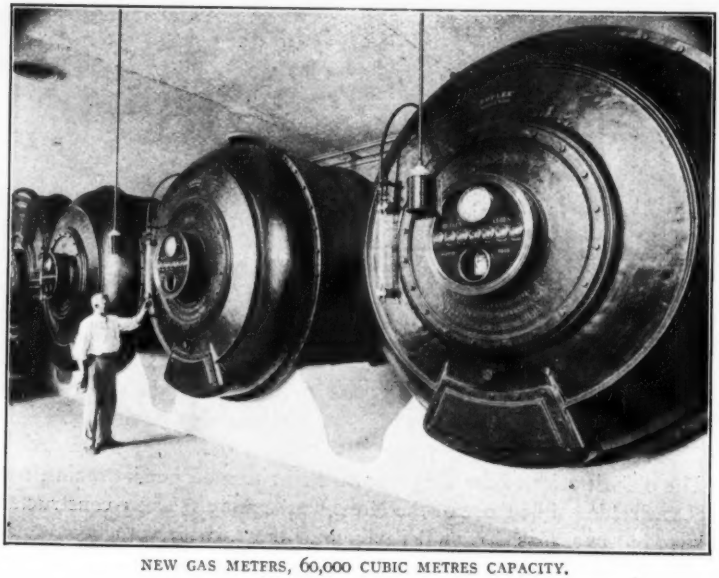
BLOWER FOR BURNING OUT GRAPHITE.

The quenched coke is carried automatically by a mechanical transporter to reinforced-concrete hoppers outside the buildings, from which it is later drawn into wagons for removal to other works. The various handling appliances (Brouwer endless chains and Sautter-Harlé elevators and transporters) are likewise electric-driven.

The gas generated in the retorts passes to the hydraulic mains. The old batteries of the No. 1 works had two independent mains, one at each side, while those of the No. 2 works more recently constructed have but one, placed over the middle of the furnace with two standpipes from opposite ends of each retort. These two sections have old-

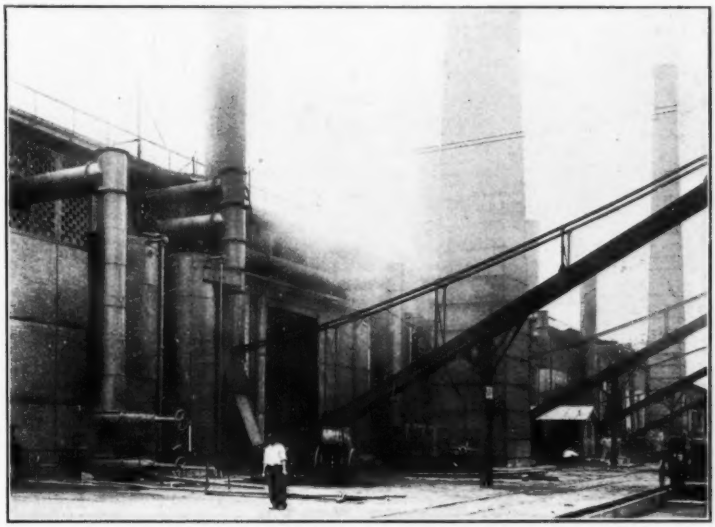


COMPRESSOR BUILDING.



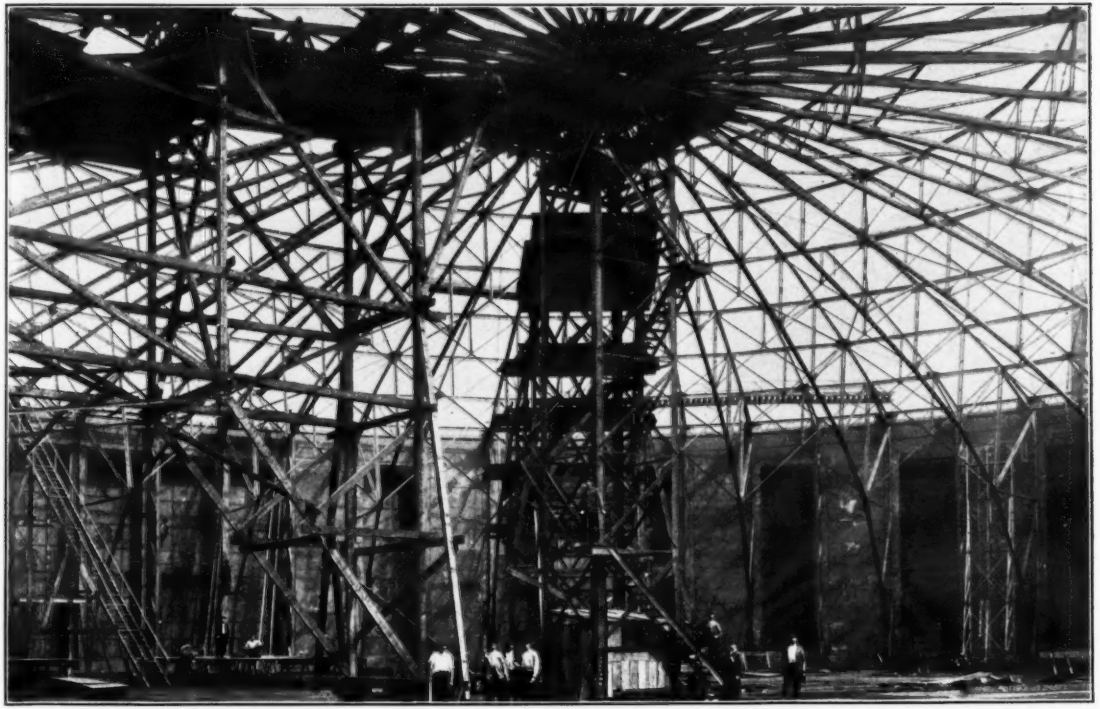
NEW GAS METERS, 60,000 CUBIC METRES CAPACITY.

style condensers, but at the No. 3 and No. 4 works, completed in October, 1910, two water-cooled tubular condensers for each battery have been installed close to the furnaces. After passing the condensers the gas passes through the usual exhausters, through the purifiers, to the gasometers. There are now in service in the two distilling plants in ordinary operation three piston exhaust pumps (two of 8,500 cubic metres, and one of 65,000 cubic metres capacity, and two Beale exhausters of 120,000 cubic metres capacity. They maintain a pressure of less than 1 centimetre of water in the hydraulic main. Four additional Beale extractors of 120,000 cubic metres capacity are installed in another building to pump the gas generated in the two new works in the course of construction.



NEW REFRIGERATING APPARATUS, REPLACING THE OLD CONDENSERS.

Without following further the processes of purification, we may note that the by-products are sent to La Villette for treatment, while the gas passes through thirteen meters, four of old model, 40,000 cubic metres per 24 hours each, and nine of the new Duplex model of 60,000 cubic metres each, place being left for installation of a tenth meter. All are arranged to operate in parallel. Beyond the meters are the gasometers. When the works is in full operation, there will be eight —five old-style simple bell gasholders, each of 30,000 cubic metres capacity, and three new style, three-lift, telescopic, each 150,000 cubic



A 150,000 CUBIC METRE GASOMETER UNDER CONSTRUCTION AT THE LANDY WORKS.

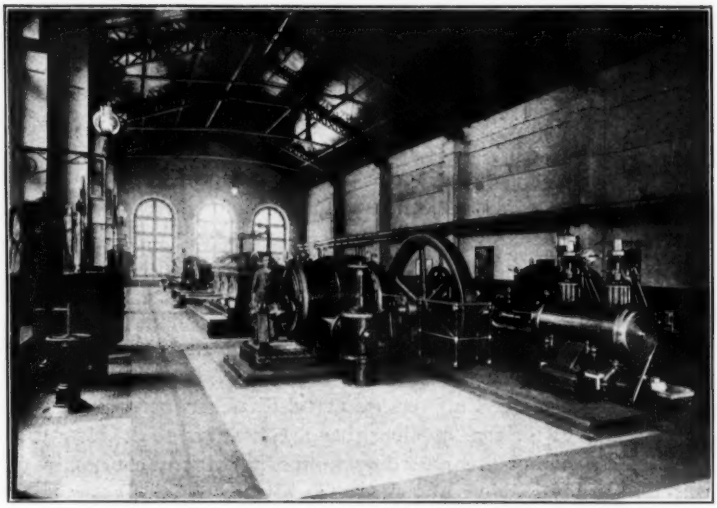
metres capacity, giving a total capacity of 600,000 cubic metres. The illustration on page 940 shows one of the new telescopic metres in course of construction; its shell resembles a vast circus 70 metres in diameter and is made of plates 39 millimetres thick. Telescopic holders will ultimately replace the old ones.

The distribution of the gas at Landy may be under the gasometer pressure only, or under a higher pressure obtained by three Rateau compressors coupled to electric motors. In addition to this, two pressure regulators with suitable valves and piping and many pressure gauges complete the distributing plant.

The compressors take the gas from the several gasometers of the Landy works and deliver it through a main conduit, one metre in diameter, to the station at Le Chatelier, where the distributing systems from the various works come together. The compressors are designed to reinforce the pressure at Le Chatelier, according to the requirements of the consumption; they are arranged to deliver a variable duty and pressure according to the indications constantly received at Landy from Le Chatelier. The discharge of the compressors is also connected with the works at La Villette so as to enable utilization of the reserve storage capacity at this latter plant for part of the gas made at Landy. It will shortly be conneced, also, wih several other works (Concorde, Clichy, Montmartre) which will operate in the same way as Le Chatelier.

Each compressor can deliver approximately 23,000 cubic metres of gas an hour at a pressure of 900 millimetres of water. They are of Rateau centrifugal type, operated directly by electric motors through elastic couplings. Each motor can develop about 140 horse power; they were specially designed at the Thomson-Houston works for the high speeds at which they must operate. The speed variations are wide and are obtained by a hand-operated rheostat.

Our review may be closed by a brief note of the central station supplying light and power for the apparatus at the Landy works. The steam plant contains eight Niclausse boilers, each evaporating 2,500 to 3,000 kilogrammes of steam an hour, at a pressure of 12 kilogrammes and a temperature of 275 degrees. They have double fire boxes automatically stoked and cleaned. They are fired with coke breeze. In two rooms symmetrically placed behind the boiler-plant are two electric generating groups, each consisting of a tandem-compound steam engine of 650 horse power, and a compound-wound dynamo of 400 kilowatts at 250 volts. The engine may be operated either non-condensing or condensing. Jet condensers and air pumps



THE EXHAUST PUMP ROOM.

are installed beneath. In each one of these stations there is a booster for a storage battery placed in a neighboring reinforced-concrete building, which houses also a water-purifying installation and a refrigerating plant.

In brief, the Landy gas works, with their remarkable mechanical handling plant, their ingenious apparatus for charging and discharging retorts, their improved furnaces, and their gigantic gasometers, are the last word in this field of technologic progress. This huge enterprise does honor to the engineers of the Société du Gaz de Paris, who have been equally solicitous for upholding their scientific reputation and for ameliorating the condition of the workers placed under their command.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

X. THE EIGHTH PRINCIPLE: STANDARDS AND SCHEDULES.

The bird is nearly a thousand times as heavy as the air its bulk displaces, but how inimitable is the work—for the way of a bird in the air remains as wonderful to us as it was to Solomon. As a child I watched a hawk soaring far up in the blue sky and sailing for a long time without any motion of its wings as though it needed no work to sustain it, but it was kept there by some miracle. I saw it sweep in a few seconds in its leisurely flight over a distance that to me was encumbered with every sort of obstacle which did not exist for it. The wall over which I had climbed, the ravine I had crossed, the patch of undergrowth through which I had pushed, all these were nothing to the bird, and while the road had only taken me in one direction, the bird's highway led everywhere and opened into every nook and corner. How wonderfully easy was its flight. There was not a flutter of its pinions as it swept over the fields in a motion that seemed as effortless as that of its shadow!—LANGLEY.

HUMMING birds winter in Central America and nest in summer in Alaska, yet bring up families as beautiful, as courageous and as achieving as themselves. The stormy petrel flies four hundred miles through the fog and strikes its burrow exactly, storks marked in Norway have been caught in South Africa, curlew and plover are supposed to fly at the rate of four miles a minute.

The barn-yard fowl, if frightened, runs and flutters over a low fence, and panting with exhaustion is soon run down. The rooster uses his wings to flap when he crows, the hen uses hers to brood her chicks, their ancestors having forgotten that they were birds and that the limitless air was their inheritance.

"Who ever heard of a woman tiring when she was having a good time, even if she had danced all night!" said Nietzsche, and the police in San Francisco on March 20, 1910, on advice of doctors present, stopped a dance after six of the contestants had been dancing 15 hours and 6 minutes.

Prof. Wm. James pointed out and insisted on the second wind, the ability that comes after first fatigue, after the barn-yard flutter, to endure and achieve, to fly!

Standards and Schedules! These are of two kinds, the physical and chemical standards discovered and established in the last century, standards and schedules as exact as mathematics, and those other schedules resting on standards whose upper limit we do not yet know. We have our five senses. We can taste or smell an infinitesimal taint in food, we can smell the millionth part of a grain of musk, we can discern by touch the ten-thousandth part of an inch, a man heard 2,390 miles away the boom of the explosion of Krakatoa, we see billions and billions of miles distant a new star bursting into brilliance; but there is a region not ten miles away about which we know less than we know of the nebulæ, because we cannot reach it with our senses, nor yet with our physics and mathematics—a region ten miles or less straight down under foot.

By bringing into play our instruments, our bolometers which measure the millionth of a degree of heat, our ultra-microscope which almost enables us to see the atoms, one one-millionth of a second measured on the tracing of a tuning fork's vibrations—by the refinements of physics and chemistry we can peer into the true inwardness of material things; so we use stop watches for time and motion studies of our machines; but when we wish to schedule work for sentient beings, then our mathematics fail and we fall back on experiments inspired by faith. Four miles a minute the flight of a little bird, 99 per cent and more the efficiency of the fire-fly's light, the sixth sense of the blinded bat, the sudden stop of the grizzly bear from full trot in darkest night when he was within a foot of the finest flower wire leading to a flash-light camera!

All around us, everywhere nature has been showing us that increased result comes from lessened effort, not from greater effort, but we have been too stupid to understand. Because it takes one pound of coal to produce one horse power, and two pounds of coal to produce two horse power, because it is harder to jump over a fence four feet high than over a fence two feet high, because it is still harder to jump over a fence five feet high, we have non-reasoned back from results to effort, and concluded that effort should be gauged by result which is in accord with one set of experiences but wholly contrary to the larger experience. Any specific kind of effort, measured by results, falls from a maximum to a minimum and then rises again to another maximum, so that there is only one point where maximum result is attained for minimum effort, a point properly scheduled at 100 per cent.

As to specific result it may be attained in many ways. Tame

geese in Germany are slowly driven to market in September, waddling a few miles each day. They are prepared for the trip by walking through soft warm tar and then through fine gravel and sand, so that, thus shod, their feet may stand the weary march. Wild geese fly from Golofnin Bay, Alaska, to the tropics in less time than the tame geese waddle a hundred miles. The wild goose's distance and time schedule would be ridiculous for the tame goose, the latter's schedule an absurdity not less cruel for the wild geese.

As to the variation in effort for similar conditions, we have but to remember that while it is pleasant to spend from six to twelve hours in bed, it is an affliction to spend all one's time in bed, a greater affliction than to have no bed and to snatch rest as one can on a long tramp or journey, for men can sleep even when walking. It is easy to walk three or four miles an hour; it is intensely wearying to stand waiting or to walk two miles an hour, when shopping with one's wife—more wearying than the five-mile an hour trot of the Yukon winter trail. It is easy to ride a bicycle 10 to 15 miles an hour, it is desperately hard to ride 1 mile an hour or 20 miles an hour, and either endeavor will send the rider exhausted to bed. How much more exhausting it is to breathe either fast or slow than to breathe naturally, the latter being absolutely effortless and kept up from birth to death, waking or sleeping. Natural breathing, natural heart beats, natural temperature, are 100 per cent efficiency.

This law of the reduction of effort for greater results crops up in the most unexpected places, so that engineers have evolved the definite critical speed, the speed of maximum result for relatively least expenditure.

In fast steamers resistance does not increase with the cube of the speed, but there are certain higher critical speeds at which resistance is less. Nearly 100 years ago in England a man running express passenger canal boats had them towed by galloping horses at a speed of nearly 14 miles an hour, claiming this was easier than a slower speed. He was ridiculed by scientists who opposed the law of cubic increase of resistance. A bet was made, dynamometers attached, and up to 8 miles the law held good; but above 8 miles the canal boat began to climb out of the water, so that at 14 miles the actual resistance was small. This was the origin of the hydroplane boat. A wise Kansas mare hitched to a plow, if it pulled heavily, would look back, take in the situation, and increase her speed. The plow immediately pulled easier because the greater speed flung the clinging earth free of the mold board, thus greatly lessening friction.

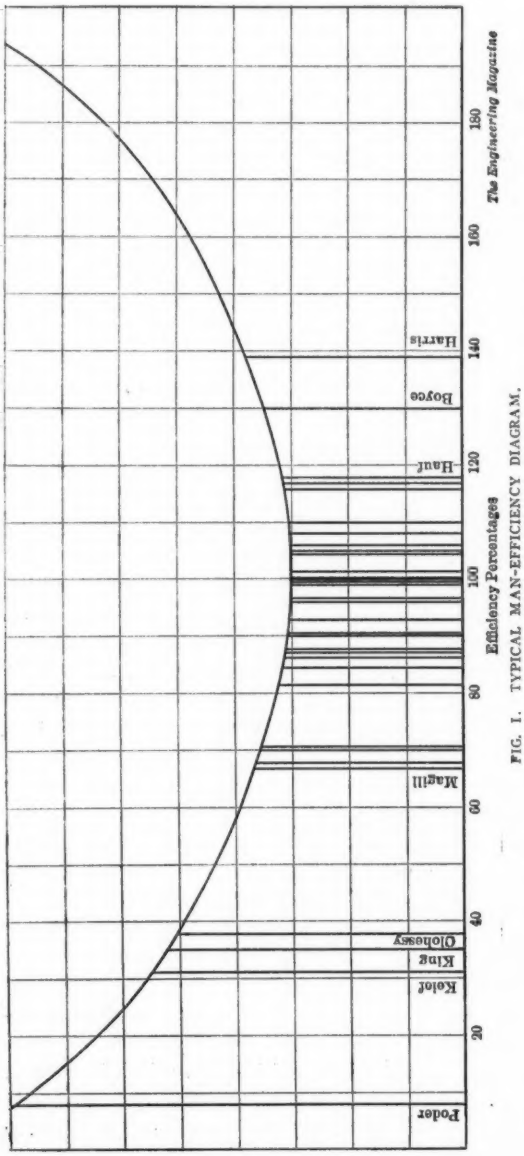


FIG. 1. TYPICAL MAN-EFFICIENCY DIAGRAM.

Time and motion studies having been made as to all the work of a gang of men, both conditions and operations were standardized and an efficiency reward was offered. The results are shown in the diagram (Figure 1). Nearly all the men are grouped between 80 per cent and 120 per cent, with the greatest density around 100 per cent—the region of least effort. The hardest worked man both psychically per unit of time and physically per unit of result, was Poder with an efficiency of 7.8 per cent. He was more exhausted at the month's end than Harris, who attained

139.2 per cent; Keief, King, and Clohessy were more tired at the day's end than Boyce and Hauf; Magill was as tired as Hauf.

A casual observation of the passengers leaving the Atlantic Highland boats at the Rector Street pier in New York on a Monday morning in summer, shows conclusively that in the crowd, some (a very few) travel over the long gallery from boat to street at the rate of 6 miles an hour; others, quite a bunch, at the rate of 4 miles; but the great body travels at the rate of 3 miles, and there are stragglers, mothers with little children, old ladies of social weight, also lingering lovers, who travel at rates shrinking to 2 miles an hour. The able-bodied, in so far as not hindered, have an average rate of 4 miles; and from these observations of voluntary effort, we can well establish a walking standard of 4 miles an hour with disapprobation if the rate falls below 3 miles, with special reward to those who reach and pass the 4-mile mark. Had we diagrammed these walkers on the pier, they would have given us a picture similar to the machine-shop curve of Poder to Harris. Both diagram and description show that the increase of effort between 100 per cent and 140 per cent is very slight—only 25 per cent, quite within the limit of normal variation above the rational average; and it also shows how possible it is for a good man to deliver nearly twenty times as much as the competent man, four times as much as the laggards, twice as much as the haphazard workers. Poder, Keief, King and Clohessy could never become Hauf, Boyce, and Harris. Piece rates based on the performance of Harris would be as ridiculous for Poder as wild-geese schedules imposed on tame geese fattening for Michelmas; but, without injustice to Keief, King, and Clohessy, the natural Haufs, Boyces, and the Harris clan can be selected for their natural work and be correspondingly rewarded.

There are places where Poder and Clohessy would fit, even as the tame goose, plucked for its feathers and prepared for the feast, shows 100 per cent efficiency, and the thin, stringy wild goose is far below par. The schedule must fit the man and the man the schedule; there is no such thing as a definite universal schedule. At best there is a broad schedule band (in the diagram, the region between 80 per cent and 120 per cent) and the records will show clearly whether the men have been selected to fit the schedule and whether the schedule fits the man. Irrespective of any current wage rate, a shop cannot be filled with the Hauf to Harris thoroughbreds for the wages that will attract the Poders and Clohessys.

If all conditions were absolutely standardized, if all operations

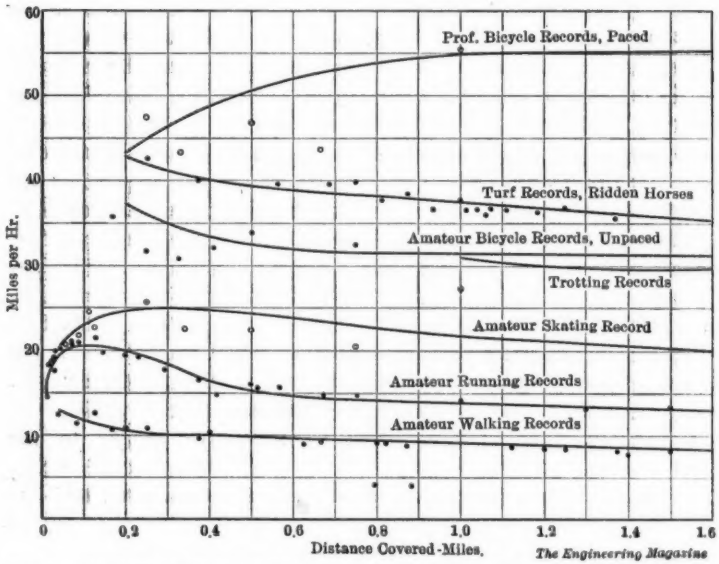


FIG. 2. DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS.

were also perfectly standardized, piece rates might apply with reasonable equity and fairness to the tame geese traveling the same road in the same weather with the same tar-sand shoes; but what about the wild geese far overhead? They must have schedules based on other standards.

In Figure 2 the speeds per hour for the best athletic records from start up to 100 miles show the time relations between different methods for the same distance.

TABLE OF ATHLETIC RECORDS.

	ONE MILE.		ONE HUNDRED MILES.		
	Actual speed	Relative speed	Actual speed	Relative speed	Relative to one mile
Amateur walking.....	9.2	100	4.8	100	52
Amateur running.....	14.	152	5.6	117	40
Amateur skating.....	21.8	237	14.	292	64
Amateur bicycle unpaced..	31.4	341	20.2	421	64
Professional bicycle paced.	55.3	601	35.5	740	64

It is known that each of these men put forth his best efforts, and assuming the men to be equal in strength, endurance, skill, we become certain that the mere addition of skates to the shoes increased

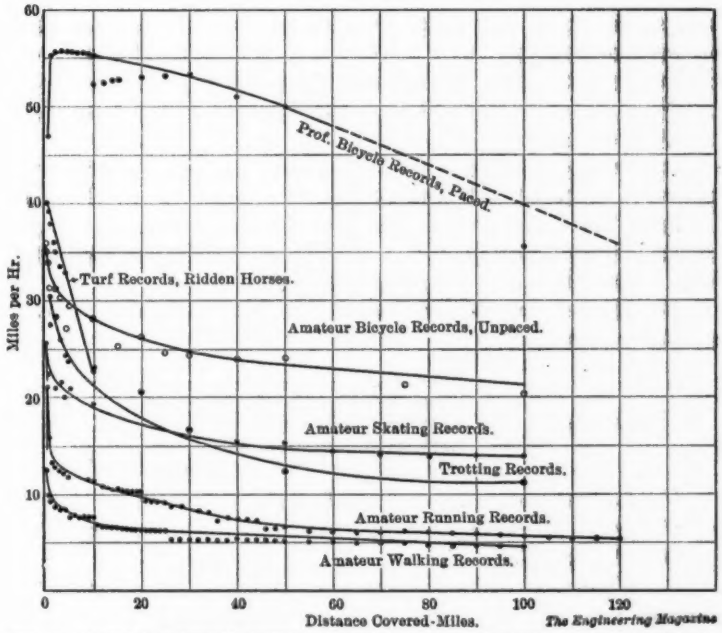


FIG. 2. DIAGRAM SHOWING SPEEDS IN MILES PER HOUR FOR BEST ATHLETIC RECORDS.

the speed for the same effort 2.37 times at one mile and 2.92 times at 100 miles; that the substitution of a bicycle for skates increases the speed 3.4 times at one mile, 4.2 times at 100 miles; and that the addition of a helping pacer, who in no way touches the rider, merely shielding him from the wind, increases the speed above walking six-fold at one mile, 7.4 times at 100 miles. All these records are of abnormal, excessive, and extreme speeds, but who can doubt that the relation would remain the same if they were halved, thus brought down to high normal—4.6 miles for walking, 28 miles for paced bicycle?

The time may come when aeroplanes rising on the wind as do the birds will glide on upward currents, as also do the birds, at a rate of two miles a minute for a thousand miles, or twenty-five times as fast as the walker, yet exert no muscular effort, using delicate instruments to feel the wind, and intelligence to guide the flyer.

Other facts appear from the table and diagram. For the 100-mile stretch compared to the one-mile stretch, both bicycle and skating fall to only 64 per cent of the speed, but walking and running collapse

respectively to 52 and to 40 per cent, so the man-used and man-driven tools not only vastly increase the speed, but maintain it at a far higher proportion. At one mile the paced bicycle rider is only six times as fast as the walker, at 100 miles he is nearly seven and a half times as fast.

It also appears that the trotting horse, who begins faster than the skater, is distanced by him at 24 miles, and after that steadily falls behind. The horse does not have the man's courage. The man helped only by his bicycle is throughout faster than the trotter, faster than the running horse after the third mile.

For physical, for chemical, and for electrical relations we can set absolute standards:

$$1 \text{ horse power} = \begin{cases} 746 \text{ watts.} \\ 33{,}000 \text{ foot-pounds per minute} \\ 2{,}545 \text{ heat units per hour} \\ 0.175 \text{ pound carbon oxidized per hour} \\ 2.64 \text{ pounds of water evaporated per hour} \end{cases}$$

Practical standards are very different—one pound of coal in steam engines per horse-power hour, 10 pounds of water evaporated per pound of coal instead of 15!

For physical standards we can measure the extent of the shortcomings and diligently strive to lessen the losses; but in making standards and schedules for man we must first classify our men, and then we must so equip them that they can as easily do six times, seven times—yes, perhaps 100 times as much.

Walking 9.2 miles an hour is as to normal walking 200 per cent efficient, not a normal standard for any regular work, but compared to the effortless glide of the aeroplane it is only 10 per cent efficient.

To establish rational work standards for men requires indeed motion and time studies of all operations, but it requires in addition all the skill of the planning manager, all the skill of the physician, of the humanitarian, of the physiologist, of the psychologist; it requires infinite knowledge, directed, guided and restrained by hope, faith and compassion.

The promise already partly fulfilled and clearly held out as to the future is that greater and greater results shall follow constantly diminishing effort.:

EDITORIAL COMMENT

Railroads and Prosperity.

IN refusing the advances in rates which the railroads of the United States have sought to impose, the Interstate Commerce Commission has taken a stand that may prove to be a turning point in the progressive exploitation of the public by "The Interests"—an exploitation heretofore almost unchecked, because resistance to it, though growing in bitterness, has lacked organization and has lacked efficient mode of expression. At the expense of momentary, but passing, consternation, the Commission has perhaps stayed a worse thing—a thing that could scarcely be defined without incurring the charge of being an alarmist.

The decision written by Commissioner Prouty outlines the conditions underlying this exploitation in a clean-cut paragraph calling attention to the interrelationship between the directorates of the railways and those of the corporations from which the railways purchase their principal supplies. The testimony of a railroad vice-president is cited to show that in the supply of locomotives, of rails, of steel structural shapes, of cars, there is no competition, but a limitation of railroad orders to two, or at best less than half a dozen, concerns. The decision goes on to say:

> Now, if the steel trust is to determine the price which shall be paid for rails and for bridges, if the locomotive trust is to determine the price of engines, the car trust of cars and the labor trust of labor, and if the railways have only to meet the demands made by these combinations and charge over to the public by an increase of rates whatever is paid, a most unfortunate situation has developed.

Most unfortunate, indeed. To realize how unfortunate we must go further even than the alarming status thus defined and look into the future as it shows itself to the officials of the railways asking the present increase. In the early part of the hearings leading up to the decision just announced, Commissioner Lane inquired of President Willard, of the Baltimore and Ohio: "Is there any reason to believe that these increases (of rates) would stop with the present increase if it should be allowed?" President Willard replied: "No, I think not. I think the tendency of rates will be to continue upward." When the Commissioner pushed the interrogation further, saying: "You think there will have to be a progressive increase?" President Willard's answer was: "Yes, sir." In the language of Mr. Brandeis's brief, actively indeed should the consumer "beware of this vicious cycle of ever-increasing freight rates and ever-increasing cost of living." Building on such a foundation, the whole structure of railway prosperity and national welfare is hopelessly wrong in plan and theory, growing to certain ruin. Yet the policy had been so long pursued, so long supported by financial duplicity, by specious argument to the ignorant and terrorism over the timid, that the way back to industrial health seemed hopeless.

The Commission did not find it necessary to go beyond the railways' own case to support their finding. This finding is that neither the credit nor the physical efficiency of American railways is impaired or is in the least danger of impairment. It may be well to remind any over-sympathetic or over-fearful person that no one except the railways themselves ever attacked or even doubted their financial soundness. Foreign investors and domestic purveyors have regarded them with absolute confidence—so regard them even yet, in spite of the industry with which the railways have

disparaged their own financial prospects. The Commission finds good grounds for the faith of investors and railway-supply interests in the showing made by the official returns—a showing of continuous progress in strength and wealth for more than twenty years, with no recent or present check and nothing to suggest uncertainty of advance along the same course. From 1888 to 1910 the percentage of railway-stock paying dividends rose from 38.56 to 67.20, and the average rate paid on dividend-paying stocks increased from 5.38 to 7.47 per cent. During the same period the surplus carried on the books of American railway companies mounted from less than $200,000,000 to more than $800,000,000. And beyond this, again, is the enormous amount taken from current earnings and put into permanent betterments. There is nothing in these figures to support a plea for the necessity of added revenue. By no standards of necessary well-being or ordinary prosperity do the railways appear to need it. By no testimony proving rising expenditures, for supplies at least, was any such demand supported. On the contrary, the cost of materials was shown to be either stationary or declining. Only in the item of labor, and there only to a limited extent, was any increase of outlay demonstrated. If as to this item the railways want relief, want a still larger margin of profit, they may go into the shippers' case and find there, constructively set forth, clearly defined ways and means for increasing net revenues without increasing rates or decreasing wages or employment.

That remarkable body of testimony setting forth the principles and results of efficiency methods—of the scientific management contributing to efficiency—which was greeted by the railways first with ridicule and then with hostility, may at length prove their salvation. We are glad to announce that it is to be made available in permanent form. The portion of Mr. Brandeis's brief presenting the case for efficiency is being issued in book form by THE ENGINEERING MAGAZINE under the title "Scientific Management and Railroads." This is put forth by the voluntary act and effective co-operation of Mr. Brandeis, not as a commercial enterprise, but as the continuation of a public service.

Science Versus "Systems."

IN view of the hasty, imperfectly informed, and not very wise propagandism of efficiency (or "scientific management") undertaken by magazines of general literature, it becomes a duty to those who, like ourselves, have been furthering the movement for more than a dozen years, now to preach caution where heretofore we have had to preach courage.

More than ten years ago, we declared editorially our recognition of the "science that forms the foundation of intelligent advance in the economy of production—a specialized branch of engineering effort—production or industrial engineering." To the ideals directing the application of this science, we later gave the designation "the philosophy of efficiency," a philosophy so widely hopeful of betterment to all that we ventured to call it "a gospel." The terms as applied to great concepts have been since attached to very much smaller ones.

Efficient management is obtainable only by the guidance of a philosophy—by the application of a science. It is based upon principles, but not reducible to any single "system." A system, however skillful, is but a method of applying principles. Industrial managers at this juncture must beware of upspringing systematizers, uninstructed in the philosophy, science, or principles of efficiency, seeking to secure its form by the mechanical application of methods, but ignorant of its spirit and so missing its results.

REVIEWS-ADVANCED PRACTICE

NOTABLE ARTICLES OF THE MONTH IN THE SOCIETY PROCEEDINGS AND TECHNICAL PRESS OF EUROPE AND AMERICA

THE OPTICAL DETERMINATION OF STRESSES.

THE ADVANTAGES, METHODS AND PRACTICAL APPLICATIONS OF OPTICAL STUDY OF STRESS DISTRIBUTION IN TRANSPARENT BODIES.

E. G. Coker—Engineering.

MANY of the structures which engineers are called upon to design, particularly those of a highly complex form, are subjected to loads which are not accurately known, and which in many cases can only be guessed at in our present state of knowledge. Take, for example, the cylinder of a large modern gas engine, with its numerous passages and ports for the inflow and outflow of hot gases and for cooling water for the jacket, and its flanges and other accessories rendered necessary for constructional purposes. This complicated structure is subjected to the high explosive pressures, to intense stresses due to the variable heating action of the hot gases, and to the cooling action of the jacket water, so that we have a combination of stresses produced in a comparatively fragile material by extreme variations of both pressure and temperature, which are not easy to determine, and, in fact, are not fully known at the present time. This is only one of many examples which might be quoted in which our knowledge of the actual conditions of loading and the state of stress produced is very deficient.

One kind of inquiry which appears to offer some scope for the elucidation of problems of this character is the determination of the conditions of stress in transparent bodies by the effects which these bodies, when subjected to such stresses, produce on polarized light passed through them. Prof. E. G. Coker, who discusses the principles and applications of this method of stress determination in *Engineering* for January 6, believes that for some special purposes transparent materials offer advantages to the investigator which are not possessed by any other material.

Prof. Coker introduces his subject with a review of the properties of light which are of importance in determining the stresses and strains in transparent bodies. We may suppose that light is due to a vibratory motion set up in an elastic medium, called the luminiferous ether, which fills all space, and that a ray of ordinary light is caused by displacements which are transverse to the direction of the beam, and have any azimuth. The velocity V of the ray depends on the transverse rigidity C of the medium and its density D, and is expressed by the relation $V = \sqrt{C/D}$. The interposition of bodies like glass retards the velocity of a ray; the retardation may be due to a change in either the rigidity or the density of the medium or in both properties. In a transparent body which has the same physical properties in all directions, changes in the ether will have the same effect on an ordinary ray of light passing through it, whatever the direction may be; if, however, the material is subjected to stress in any prescribed manner, the properties of the ether may alter and affect the properties of the ray in certain directions. Since the vibrations of

the ether are taking place in all planes passing through the line of direction of the beam, such a change is not observable under ordinary circumstances; but if the vibrations are confined to one plane, the differences in the physical properties of the material, due to the applied stress, generally cause a break-up of the wave motion into two components, vibrating in directions at right angles, and moving with different velocities in the body.

This property of "double refraction" is possessed by many natural bodies having an ælotropic structure, and is due to the way in which the molecular constituents arrange themselves in certain definite directions, as in a crystal. It is well known that Iceland spar possesses this property. Double refraction may be produced artificially in various transparent bodies, notably glass, by the application of external forces, whereby the material becomes doubly refracting, and the interference effects between the two rays produce color bands, which are extremely delicate indications of the state of stress in the material. Taking a simple case of two sources of light emitting waves of one kind of vibration only, the effects of interference can, by suitable optical devices, be made visible to the eye by the production of dark and light bands, and these latter give a uniformly tinted field corresponding to the same kind of vibration as each source. If, however, we use white light, which is composed of waves of different lengths corresponding to the colors of the spectrum, the results of interference generally produce color effects ranging over the whole spectrum.

Materials which are naturally doubly refracting, or which are made so by the application of stress, have the power of decomposing a plane-polarized ray (a ray passing through a doubly refracting crystal, such as a crystal of Iceland spar, parallel to the "optical axis" of the crystal, which is not broken up into two rays, but which has its vibrations "polarized" into one plane) into components at right angles, which, on recombination by suitable apparatus, produce interference effects. Hence this distinctive property makes it possible to investigate the state of stress in the interior of a transparent body, if we have suitable optical apparatus for the production of a beam of polarized light. The most convenient apparatus is the well-known Nicol's prism, a modified form of crystal of Iceland spar. For the examination of specimens under stress it is convenient, for photographic purposes, to have a strong point source of light, such as that obtainable from an arc lamp, and to pass the beam through a large Nicol's prism, or an equivalent arrangement, to plane-polarize it. This beam is then transmitted through the specimen under stress, and the components of the two sets of rays produced are recombined by a second Nicol's prism, and the resulting interference effects projected on to a sheet of squared paper or a sensitive plate.

"If we pass a beam of plane-polarized light through a specimen of a transparent material, as, for instance, glass, we find that if the polarizing Nicol and the analyzing Nicol are set with their principal planes at right angles to produce a dark field, the interposition of a piece of glass makes no difference to the field of view, but that even a slight stress produces a color effect, and that for every variation in the intensity of a uniform stress a correspondingly uniform color is produced, provided the material remains elastic. A color scale may thus be formed which for pure tension or compression stress indicates its numerical value, and a relation between them may be readily established. For examining the behavior of a beam subjected to uniform bending moment, for instance, the actual stress in it may be determined by the color fringes produced by the interference of white light, or, probably with more accuracy, by using monochromatic light. As may be surmised, there is considerable difficulty in estimating the amount of stress from the color produced, and this is especially the case with colors like yellows and reds; but this difficulty may, to a great extent be removed by a process of matching colors. In order to do this the object under observation is arranged close to a uniformly stressed test piece, and the load applied to this latter is ad-

justed until the color effect produced corresponds to that at some point of the object where the stress is required."

Prof. Coker's paper is illustrated with eighteen reproductions by the three-color process from colored photographs taken on Lumière plates direct from specimens under stress. Two of these show the colors obtained in a beam of rectangular section, loaded with a uniform bending moment; they show that the stress varies almost directly as the distance from the neutral axis, the position of which is marked by a dark band at the centre. Four of the illustrations show interesting examples of the effects of semi-circular and V notches on the stress distribution in tension and compression members. Other subjects illustrated include a corrugated furnace flue section in tension, circular hooks and circular chain links, a locomotive plate spring, a square-headed screw and nut, a pillar with pin-jointed ends, and a trussed beam centrally loaded, and also with the load on one side of the central section. Prof. Coker demonstrates the applicability of this method to determine not only the nature of the stresses produced, but also their magnitudes, by taking a case in which the stresses may be independently calculated. He takes a tie bar loaded eccentrically by a definite amount, and shows that the measured stress effects agree very closely with the calculated values. In his opinion, this and other examples which might be quoted show a sufficiently close agreement with theoretical calculation to justify the application of optical methods to the study of problems for which no theoretical results are available.

"To apply this kind of experimental work to cases of practical importance, it is evidently desirable that the material used should possess similar physical characteristics to those possessed by steel, iron, and other materials in general use by engineers, and in this respect glass is probably superior to any other transparent material. Unfortunately, however, in order to produce the color effects in glass specimens, it is necessary that the material should be very thick, and the forces to which the glass is subjected very great—in fact, very near the breaking point of the material. Glass is, moreover, an extremely difficult material to shape, and specimens can only be produced by laborious processes.

"The extensive commercial use of xylonite and such-like preparations in recent years, however, affords a material which has nearly all the desirable features of glass, and, in addition, some other characteristics which make it superior to glass in many respects for this kind of experimental work. Xylonite is a preparation of nitro-cellulose, which may be obtained in large sheets of moderate thickness, entirely free from stress except at the edges. It is not usually made more than one-eighth inch thick, but as it is so much more compressible than glass, it is, generally, more convenient for use in these thin strips. The material is not quite so transparent as glass, and is usually slightly tinted; but it has the very important advantage that specimens may be cut from the sheet quite readily with ordinary wood and metal-working tools, and with reasonable care the contours of the specimen show no signs of residual stress after shaping."

Whatever be the shape of a plane lamina and the nature of the applied forces, the stresses at a point may be represented by two principal stresses at right angles, while the angular positions and magnitudes of these principal stresses will usually vary from point to point. If the plane of polarization coincides with one of these principal stress axes, the ray passes through unchanged, and therefore, with the polarizer and analyzer set with their principal planes at right angles to produce a dark field, we still obtain a dark field in the object wherever the direction of the principal axes of stress correspond with the principal planes of the Nicols. In determining the condition of stress by plane-polarized light in other than the simplest cases, this disturbance must be eliminated. Its elimination is effected by combining with each Nicol's prism a quarter-wave plate set with its axis inclined at 45 degrees, thereby converting the plane wave issuing from the first Nicol into a circularly polarized ray—that is, a ray of plane-polarized light in

rapid rotation about its line of direction, which therefore presents the same aspect to every part of the stressed material.

"It has been mentioned above that at any point in a plane lamina, the state of stress can always be completely represented by two stresses at right angles; and if their directions and magnitudes are known over the whole specimen, the state of stress is completely determined. The optical method is particularly well adapted for the determination of direction of the lines of principal stress from the fact that plane-polarized light has a selective action, since it does not allow light to pass through the stressed specimen at any place where the principal planes of the Nicols are parallel to the planes of principal stress. For any arbitrary position of the crossed Nicols, therefore, we obtain a series of dark bands, which are the loci of these positions, and, by setting the crossed Nicols in new positions, we obtain other bands corresponding to new axes of principal stress."

By means of optical methods, "it is possible in most cases of complicated constructions, such as are met with in girders, trusses, rivetted joints, pillars, notched bars, and the like, to form some approximate idea of the distribution and magnitude of the stresses from models. . . . In addition to their value for experimental investigations, optical methods appear to have a certain amount of value for educational work. It is probably a very common experience that engineering students rarely show the same degree of enthusiasm for the study of the theory of elasticity as they do for the study of other branches of science, such as heat engines, for example. It is difficult to realize what is the internal condition of beams, shafts, and the like, when they are bent, twisted, or otherwise stressed; and the average student, especially if he comes direct from school, does not readily grasp the meanings of the symbols he uses, or the significance of the formulæ he obtains, because of lack of illustrations of the nature of internal stress. With a limited amount of experience it seems quite safe to say that the pictures which optical experiments present to the eye afford a measure of help to students, whether they are intelligent workmen or the more systematically trained students of an engineering college."

THE LICENSING OF CIVIL ENGINEERS.

AN ABSTRACT OF THE MODEL LAW DRAFTED BY A COMMITTEE OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

American Society of Civil Engineers.

STATE control of the practice of engineering is being so widely urged in the United States that the question has become one of the utmost importance to the engineering profession. Bills regulating the practice of engineering have been introduced in a number of state legislatures, and in a few instances these bills have become law. The agitation against the Raldiris Bill introduced last year in the legislature of the State of New York brought the question prominently before the American Society of Civil Engineers, and about a year ago the Board of Directors of that body declared it the duty of the American Society to use its influence to secure legislation not prejudicial to the engineering profession in any state in which the regulation of the practice of engineering is demanded. In pursuance of this policy the Board of Directors, at the annual meeting in January last, offered the law abstracted below as a model for state legislatures who deem the regulation of engineering advisable for the protection of the public. At the same time they express the opinion that no legislation of the kind is needed, the public being amply protected if they will employ only those engineers who have demonstrated their ability, and both this opinion and the draft of the model law were approved by a practically unanimous vote of the members of the Society.

Civil engineering is defined in the Act as the practice of any branch of the

profession of engineering other than military. The branches of the profession specifically mentioned, without prejudice to the design and supervision of other public or private utilities or works which require experience and like technical knowledge, are the design and supervision of the construction of public or private utilities, such as railroads, bridges, highways, roads, canals, harbors, river improvements, lighthouses, irrigation works, water supplies, sanitary and drainage works, of works for the development, transmission and application of power, and of electrical, mechanical, mining, industrial, hydraulic, municipal, sanitary, structural and other works which require experience and the same technical knowledge as engineering schools of recognized reputation prescribe for graduation.

The Act provides for the appointment by the Governor of the State of a State Board of Engineering Examiners of nine members, each of whom shall hold office for six years, and three of whom shall retire every two years. Each member of the Board shall be a professional civil engineer at least 35 years of age, shall have had at least ten years' active practice, shall be of recognized standing in the profession and licensed under the Act, and shall have been a resident of the State for at least one year immediately preceding his appointment.

The Board shall admit to examination any candidate who pays the established fee, and submits evidence, verified by oath and satisfactory to the Board, that he is more than 21 years of age; is of good character; has been engaged actively in civil engineering work, as assistant or otherwise, for at least six years, and has had charge of engineering work for at least one year; or is a graduate from a school of engineering of recognized reputation, and has been engaged actively in civil engineering work, as assistant or otherwise, for at least four years, and has had charge of engineering work for at least one year.

Within one year after the Act goes into effect, the Board shall issue a license to any candidate making due application and paying the proper fee, who furnished evidence satisfactory to the Board that he is qualified for admission to examination under the provisions mentioned above and has practiced civil engineering for an additional period of not less than four years immediately preceding. After the expiration of one year, and in all other cases, the Board shall issue licenses only on examination. Examinations for licenses shall be held at such times and places as the Board may specify, and their scope and the manner in which they shall be conducted shall be wholly at the discretion of the Board. Successful candidates shall be given the Board's license to practice engineering, on payment of the proper fee. Unsuccessful candidates at a first examination may, at any time between six months and a year after, again present themselves for examination without additional fee.

The Board shall issue licenses to residents of other states, the licensing standards of which are approved by the Board, on presentation of satisfactory evidence that they are properly licensed in their home states; or to residents of states not so approved on the presentation of satisfactory evidence that they are qualified as specified above for candidates for examination, and have in addition practiced civil engineering for an additional period of not less than four years immediately preceding application. No unlicensed person shall qualify as an expert witness in any State or municipal court, and no map, plan or drawing required by law to be certified or approved by a civil engineer shall be accepted by State or municipal authority unless the certification shall be executed by a duly licensed person.

The Board shall have power at any time to inquire into the identity of any person claiming to be a licensed civil engineer. It may revoke the license of a practitioner and annul his registration, if he has been guilty of any fraud or deceit in his practice, or has been guilty of any fraud or deceit by which he was granted a license to practice, or has been convicted of crime. When charges are preferred, they shall be heard by a committee of six members of the Board. The accused shall be notified of the time and place of the hearing by personal service, if possible, or by publication, if

the accused cannot be found. At the hearing the accused shall have the right to cross-examine witnesses, to produce witnesses in his defense, and to appear personally or by counsel. On the recommendation of two-thirds of the committee hearing the charges, the Board may, at its discretion, revoke and annul the registration of the accused.

Any unlicensed person practicing, or attempting to practice, civil engineering, or who shall use in connection with his name any designation tending to imply that he is a practitioner of civil engineering, and any person violating the provisions of this Act, shall be deemed guilty of a misdemeanor. Any person attempting to file as his own the license of another, giving false or forged testimony before the Board, practicing civil engineering under a false or assumed name, or falsely impersonating a practitioner of like or similar name, shall for each offense be punished by a fine of not less than $100 nor more than $500, or by imprisonment for three months, or by both fine and imprisonment.

The Act shall not apply to engineers working for the United States Government; nor to any engineer employed as an assistant to an engineer licensed to practice civil engineering; nor to any engineer coming from another state and employed by the State or any municipality, corporation, firm, or individual therein, until a sufficient time shall have elapsed to permit the licensing of such person.

A STUDY OF PAINT VEHICLES.

AN INVESTIGATION OF THE VALUE OF CERTAIN PAINT OILS, AND OF THE EFFICIENCY OF DRYING MATERIALS.

Henry A. Gardner—Journal of the Franklin Institute.

FOR certain technical paints, linseed oil is not an entirely satisfactory vehicle, and the search for a substitute has received a good deal of attention from paint chemists. Just at present interest in the problem is unusually keen, on account of the comparative scarcity of linseed oil, and for the same reason the market is flooded with so-called substitutes. None of these, according to Henry A. Gardner, has yet demonstrated that it possesses a practical efficiency greater than that of linseed oil. Mr. Gardner has been engaged for some time in an investigation of the various oils offered as paint vehicles. His results, which are published in the *Journal of the Franklin Institute* for January, indicate that many oils other than linseed may possibly be of use as paint vehicles, but he is careful to point out the danger of using them until their composition is understood or their value determined in a practical way.

"It is well known that a most desirable feature of paint oils is their ability to set up in a short period to a hard surface that will not take dust, that will stand abrasion and offer resistance to moisture and gases. This drying property is dependent upon the chemical nature of the oil. If it is an unsaturated compound, like linseed oil, rapid absorption of oxygen will cause the film to dry rapidly and become hard. If the oil be of a fully satisfied nature, like mineral oil, for example, oxygen cannot be taken up to any great extent and drying will not take place. The various animal and vegetable oils differ in their power of oxygen absorption to a lesser or greater extent. This difference is referred to by the chemist in terms of the iodine value. The iodine value of linseed oil is approximately 190, meaning that one gram of the oil will take up 190 centigrams of iodine."

Soya-bean oil, obtained from the seeds of the *Soya Hispida*, a plant indigenous in Manchuria but raised extensively in the Southern States for cattle food, is being imported into the United States in large quantities and is being exploited as an efficient paint vehicle. Its iodine value is around 130, and its iodine value is the only chemical characteristic that markedly differentiates it from linseed oil. As to the most efficient drier for use with soya-bean oil, Mr. Gardner has found that the percentage of lead or of

manganese, or of lead and manganese, giving maximum efficiency in the drying of linseed oil gives also the best results with soya-bean oil. Soya-bean oil paints without drier, however, take about twice as long to dry as similar linseed-oil paints, although laboratory tests with mixtures of the two oils indicate that a moderate percentage of soya-bean oil is not detrimental with linseed oil.

Tung oil, or Chinese wood oil, used extensively in the manufacture of varnishes, has been seldom, if ever, used as a paint oil. Yet for certain technical paints for the protection of concrete and steel, for the waterproofing of structures, and for other purposes, manufacturers may find this oil, or its products, most useful. Metallic tungates have been shown to be most excellent driers, and the high iodine value of tung oil, around 170, makes it a very rapid drier, even faster than linseed oil. The soft and opaque film it leaves upon oxidation, however, makes necessary treatment by special processes when it is used for either varnishes or paints, except in special cases. Mr. Gardner has prepared the tungate of lead by precipitating saponified tung oil with lead acetate. This tungate, after it has been freed from water, may be fused with a small percentage of colophony and borate to produce a rapid drier which gives a perfectly clear film.

Menhaden oil, derived from marine animals, has an iodine value around 160. It dries fairly rapidly and its composition would indicate that it might possess considerable merit. Toch claims that it is of great value for smoke-stack paints, and for zinc paints exposed at the sea shore. Its content of stearine may account for certain waterproofing properties claimed by producers, and would suggest its use in paints for the protection of iron and steel.

Of the other oils investigated by Mr. Gardner, rosin oil, the product of the dry distillation of rosin, has a low iodine value and a high acid value which unfit it for use as a paint vehicle. Cottonseed oil and corn oil are both light in color, and although greatly inferior to even soya-bean oil in drying action, merit further investigation. Sunflower oil is high in iodine value and light in color; it is, however, very scarce, although there is no reason why it should not be produced in larger quantities for use as a paint oil. On Perilla oil, obtained from Perilla nuts, indigenous in Manchuria and the East Indies, no tests have been made, on account of its scarcity, though it has an iodine value of 206. Waste oil, obtained from city garbage, seems to have little value as a paint oil, but its use in combination with linseed oil to produce a soft, elastic, water-repellant film for paints to protect iron and steel submerged in sea water should be studied. The blown and oxidized linseed oils, the debloomed mineral oils, and the so-called Japan oils on the market should not be used until practical tests of their value have been made.

DRYING TESTS OF OILS.

Sample.		Hours.
No. 1.	*Pine oil	2½
No. 2.	Tung oil	2¾
No. 3.	Linseed oil	3
No. 4.	Linseed oil.....25 per cent Soya-bean oil.....25 per cent Menhaden oil.....25 per cent Tung oil.....15 per cent Lead tungate.....10 per cent	3
No. 5.	Linseed oil.....75 per cent Chinese wood oil....25 per cent	3
No. 6.	Linseed oil.....75 per cent *Pine oil.....25 per cent	3
No. 7.	Linseed oil.....50 per cent Menhaden oil.....25 per cent Soya-bean oil.....15 per cent Lead tungate.....10 per cent	3¼
No. 8.	Menhaden oil	3½
No. 9.	Soya-bean oil	3½
No. 10.	Linseed oil.....80 per cent Waste oil.....10 per cent Lead tungate.....10 per cent	3½
No. 11.	Linseed oil.....75 per cent Soya-bean oil.....25 per cent	4
No. 12.	Linseed oil.....75 per cent Corn oil.....25 per cent	5½
No. 13.	Linseed oil.....75 per cent Cottonseed oil.....25 per cent	6½
No. 14.	Linseed oil.....75 per cent Rosin oil.....25 per cent	10
No. 15.	Corn oil	8
No. 16.	Cottonseed oil	9
No. 17.	Rosin oil	Not dry in 2 days

* Pine oil referred to is not rosin oil but the high-boiling-point distillate of wood turpentine.

The accompanying table gives the results of drying tests made by painting thin films of oil on glass plates, which were exposed to the atmosphere, and the time of drying carefully observed. The results do not indicate the wearing values of the oils tested, but simply their relative drying values. In all cases except samples No. 4 and No. 7, 10 per

cent. Drier X was added. Although sample No. 2, untreated tung oil, dried with Drier X more rapidly than untreated linseed oil with Drier X, Mr. Gardner believes that the linseed oil would be more serviceable. Drier X was a strong lead and manganese linoleate drier. The pine oil referred to is not the pine oil of commerce, but a material of high boiling point obtained as a by-product in the refining of wood turpentine manufactured from sawdust. Its boiling point is over 210 degrees C., as against 150 degrees C., the boiling point of ordinary gum spirits. It is almost water white, has the same penetrating qualities as the pure gum spirits, and is almost free from objectionable odor. When mixed with 50 per cent. linseed oil, this product forms a paint oil of extremely light color and most excellent properties, producing a semi-flat paint of great whiteness. If exposure tests substantiate the results of these preliminary investigations, it would appear of great importance to Southern manufacturers to produce this material in quantities by fractional distillation of the crude spirits. Its iodine value is high and its oxygen-carrying properties are good. Its evaporation leaves a durable film.

In another series of tests, Mr. Gardner has investigated the effect of driers on linseed oil. Varying amounts of lead oxide, of manganese dioxide, and of mixtures of the two driers were mixed with pure linseed oil, and samples of the mixtures were exposed for twenty days on tin plates to a current of washed and dried air, and also to a current of damp air. We have not space to reproduce Mr. Gardner's numerical data of the results of these tests, but confine ourselves to his summary of the conclusions drawn from them. "In the case of lead oxide," he says, "an increase in the percentage of lead oxide in the oil causes a relative increase in the oxygen absorption, but when a very large percentage of lead has been added, the film of oil dries to a leathery skin.

"In the case of manganese oxide, the increase in oxygen absorption on the first day is much more pronounced than is the case with lead oxides. Furthermore, the oxidation of manganese oils seems to be relative to the increase in manganese up to a certain period, when the reverse of this law seems to take place, and beyond a certain definite percentage of manganese, added percentages seem to be of no value. It was furthermore observed that the films dry to a more brittle and harder skin than is the case with lead oxide. The oxygen absorption with oils high in manganese has been noticed to be excessive, and the film of oil becomes surface-coated, drying beneath in a very slow manner, a condition that often leads to checking. The critical percentage where the amount of manganese appears to be most propitious and renders the greatest efficiency seems to be 0.02 per cent. This critical percentage, as it may be termed, should not be exceeded, and any added amount of manganese has the effect of making the film much more brittle and causes the so-called 'burning up' of the paint. The loading of paint with drier and the bad result therefrom, may be explained to some extent from the above.

"In the same way with lead driers, excessive amounts of lead oxide seem to have no beneficial effect on the drying of an oil, and when the percentage which seems to be the most beneficial, namely 0.5 per cent. lead oxide, is exceeded, the film is apt to become brittle. Oils containing lead oxide driers are less influenced in their drying tendencies by conditions of moisture in the atmosphere than oils containing manganese, but frequently, however, the former dry much better in a dry atmosphere. As a general rule, varnishes rich in manganese dry more quickly in a dry atmosphere, while those containing small quantities dry more quickly in a damp atmosphere. . . .

"The results of this investigation would indicate that when lead or manganese linoleates are used, the most efficient results may be obtained with 0.5 per cent. lead or with 0.05 per cent. manganese or with a combination of 0.5 per cent. lead and 0.02 per cent. manganese. Until more definite results have been obtained with the *tungates*, which will probably prove of exceptional interest as driers, the above driers will probably be used to the greatest extent."

STREAM GAUGING DURING THE FROZEN SEASON.

AN OUTLINE OF THE DIFFICULTIES, AND A DESCRIPTION OF THREE METHODS APPLICABLE TO DIFFERENT CONDITIONS.

C. Robert Adams—Engineering News.

ACCURATE records of stream flow are of the highest importance in the solution of engineering problems connected with the development of water power, water-supply projects for irrigation and domestic purposes, the prevention of floods, the navigation of rivers, and the drainage of overflowed and swamp lands. Largely through the studies of the Water Resources branch of the United States Geological Survey, methods of estimating stream flow during the open-water season have become well standardized. When we come to winter measurements, the case is different. The difficulties of making stream-flow estimates during the frozen season have prevented methods of winter measurement from reaching finality, and they are still in a more or less experimental state. C. Robert Adams shows, however, in an article contributed to *Engineering News* for February 2, that accurate winter determination of stream flow is largely a matter of judicious choice of gauging stations.

The estimation of stream flow during the open season involves the determination of the daily discharge at certain places known as river stations. These stations are ordinarily of two types, which require different methods of measurement. At regulated-flow stations, located at dams where water power is developed, the daily discharge is computed from ratings of the turbines, the flow over spillways, and the flow through waterways. Natural-flow stations are located at points where for a given elevation of water surface at a gauge a certain definite quantity of water is passing, and estimates at such stations are based upon rating diagrams determined from measurements of discharge taken at various gauge heights. Average daily gauge heights are obtained at a gauge, and from them the daily discharges are taken from the rating chart for the station.

Neither of these methods is applicable to the frozen season without some revision. Ratings of turbines are not affected, but ratings of wasteways and spillways are changed unless they are kept clear of ice obstruction. Where it is impossible to keep spillways and wasteways clear of ice, it is necessary to rerate them with all considerable changes in ice conditions. At natural-flow stations gauge heights become so affected by ice that in the majority of cases the open-water rating curve cannot be applied. It has been found also that gauge heights to water surface have in almost all instances no constant relation to the discharge.

Data obtained from 20 river stations of the U. S. Geological Survey, quoted by Mr. Adams, indicate that the coefficient for reducing open water to ice conditions with gauge heights to water surface (called C) is more uniform than the coefficient for reducing open water to ice conditions with gauge height to bottom of ice (called C^1). There is, therefore, a more constant relation between discharge and gauge height to water surface than there is between discharge and gauge height to bottom of ice.

Streams are determined in water-surface elevation by a successive number of what may be called "control points," varying more or less in number and in position as the river stage changes. These control points may be dams, natural falls, rapids, bars, or stretches of constricted cross section. They act in the general nature of weirs, in that the water-surface elevation for the stretch above a control point is determined by the height of water at the control point, and is so determined upstream to the next control point.

The most important thing about an ice cover, so far as winter estimates are concerned, is the extent to which it is in flotation. If the ice cover extends only part way across the channel it is not

strong enough to support itself as a cantilever, and consequently must be in flotation. If it extends wholly across the stream, it is either in a state of flotation, or else acts as a beam supported at both ends. Mr. Adams quotes experimental data which indicate that in a large majority of cases ice upon frozen-over streams is actually in flotation. Considering this fact in connection with the fact that control points determine the water-surface elevation, it follows that the usual change produced by the appearance of an ice cover is to cause a general increase of water-surface elevation without increased flow.

The ice cover increases the friction of the wetted perimeter of the flowing stream, causing the water-surface slope between control points to be increased. The increase is greater in rapidly moving streams, and is practically zero in streams of small mean velocity and short distances between well defined control points. In the special case of a weir and pond the result is to cause no increase in water surface above and near the weir, and the open-water rating table for the weir will apply equally well where there is an ice cover. The same law will hold wherever the control point is well defined, when it is free from obstruction, and when the ice cover from the gauge to the control point is in a state of flotation. When the other conditions hold, but the control point becomes partly clogged with ice, the open-water rating table does not apply, but another table does apply wherein the gauge height to water surface is still applicable. When the control point is not well defined, when it is obstructed, and when the ice is not in a state of flotation, this principle applies less and less exactly until a point is reached where gauge heights to water surface do not have a simple relation to discharge. Hence, whenever gauge heights are used as a basis of winter estimates under ice cover, these gauge heights should be to water surface, and will apply only where stations are favorably located. It follows that the nearer C at any station is to unity, the better is that station for obtaining winter estimates. The nearer C is to unity, the more constant it is likely to be; thus C becomes a test to apply to present stations to determine in how far they are affected by ice, and also to determine the best method of making winter estimates.

Mr. Adams gives three methods of making winter estimates in the order of their efficiency. The first is recommended for present river stations where C remains at or near unity, and for similar station which may be located in the future. The most important consideration is the proper location of the gauge, which should be above and close to a well defined control point which will remain fairly clear of obstruction, and should be located so that all ice between it and the control point will be in a state of flotation. Mean daily gauge heights may then be applied to the open-water rating curve, though measurements of discharge may well be made once or twice during the winter as a check.

The second method is recommended for those streams where it is impossible to obtain satisfactory control points. It is practically a series of discharge measurements. A discharge measurement is made as soon as freezing commences, as evidenced by the rising gauge heights unattended by any reason for increased flow. A second measurement of discharge is then made as soon as the ice cover becomes permanent. Afterwards discharge measurements are made whenever the gauge height to water surface indicates a considerable change of discharge. Between discharge measurements estimates of flow are made by interpolation, and not by the use of gauge heights.

The third method is to use stations of the dam type, computing the flow as the sum of discharge through water wheels, through wasteways and over spillways. The procedure is to keep the wasteways and spillways free from ice obstruction, so that open-water ratings may be applied. If this procedure is impossible, it is necessary to rerate these wasteways and spillways as often as ice conditions change to any great extent. At best this third method is very laborious, and in the majority of cases will probably produce results of less accuracy than either of the two other methods of measurement.

AN OCEAN-GOING OIL-ENGINE SHIP.

A BRIEF DESCRIPTION OF THE MACHINERY OF THE TRAMP TANK VESSEL, "VULCANUS," THE PIONEER OF A NEW NAVIGATION.

The Engineer.

A LONG step in the direction of the general application of the internal-combustion engine to marine propulsion has been taken in the *Vulcanus*, a vessel designed and built in Amsterdam for service between Holland and Borneo, the pioneer of full-powered, ocean-going, commercial vessels equipped with oil engines. In the opinion of *The Engineer*, the *Vulcanus* marks the first clear step in a new epoch. One of the principal causes of delay in the introduction of the internal-combustion motor afloat has been a too servile adherence to pure motor practice, regardless of the conditions of marine-engine operation. In the powering of the *Vulcanus* a really serious attempt has been made to bring the internal-combustion engine into line with the teachings of experience and to profit by the lessons of marine steam practice. This is the most striking feature of the design of her propelling machinery, which is briefly described below, after a description in *The Engineer* for January 6.

"The ship has been constructed by the Nederlandsche Shipbuilding Company of Amsterdam for the Nederlandsche Indische Tankstoomboot Company for the carriage of three different grades of oil—petroleum, crude oil, and spirit—in bulk from the company's Borneo wells to its distributing centres. She is of the turret deck type, which is found to provide very convenient expansion chambers for the oil, while at the same time controlling the 'surge.' She is of 1,900 tons displacement, is 196 feet in length by 37 feet 9 inches beam, and 13 feet 2½ inches deep,, with a mean draught of 10 feet 2 inches; she has a speed of 8.4 knots. She is built of steel, under Lloyd's survey, with steel decks, and has the bridge amidships and machinery aft.

"It is, however, below that the real interest lies, and here will be found a six-cylinder, four-cycle, single-acting, reversible Diesel motor, having cylinders 400 millimetres diameter by 600 millimetres stroke, giving about 500 brake horse-power at 180 revolutions per minute. On entering the engine-room it is seen that the arrangement of valves follows ordinary Diesel practice, they being inverted in the cylinder heads. There are, of course, four valves, viz., those for the inlet, exhaust, fuel, and compressed air for starting. Each of these is operated by a very neat-looking, straight and symmetrical cast-steel rocker from the overhead cam shaft, those rockers for the fuel and compressed air being mounted eccentrically to each other on a common pivot, the position of which is controlled by a lever on the starting platform, so that when one is in gear the other is out of action, and *vice versa*, as will be mentioned later. Then comes what is probably the most interesting part of the whole engine—the valve actuating and reversing arrangement. Running along the front of the cylinders is a shaft corresponding exactly to the weigh shaft of the reversing gear of a steam engine, but instead of the arms, drag links and links, it carries rigidly attached to it Y-shaped brackets, the arms of which terminate in adjustable bearings in which run two cam shafts, one for ahead and one for astern going. At the after end of this weigh shaft, and separate from, but concentric with it, is a short length of shaft, with a two-throw crank between the two bearings, in which it is supported, and having attached to its forward end by a flanged coupling, a small toothed pinion. This pinion meshes with two spur wheels of double the diameter on the ends of the cam shafts, and thus it will be seen that the weigh shaft rotates the spur wheels round the pinion and sets either the ahead or the astern cam shaft in position to operate the rockers, and thus ahead or astern movement will be ob-

tained, while both the spur wheels remain in gear, and both shafts are in motion when the engine is running. Rotary motion is transmitted from the engine to the little crank shaft mentioned above (and so through the pinion to the cam shafts) by means of a pair of hollow coupling rods, working at their upper ends on the two little cranks and attached at the lower ends to eccentrics on the main shaft.

"The next point to notice on the way down to the foot-plate is the arrangement of cylinders, pistons, and rods. The cylinders are cast in two blocks of three each, with open bottoms, and fitted with cast iron liners. The pistons are not of the trunk type, as usual, but are short pistons, each having no less than ten rings to make sure of retaining the high compression pressures. They have no side thrust to take up. They are hollow and are cooled by air supplied by a fan, friction-driven off the fly-wheel of the engine. This air is admitted by means of telescopic tubing into the body of the piston and exhausted into the atmosphere. The piston-rods are provided with a spigoted coupling at the top, by which they are attached by studs to the piston; the rods then pass through bushes into the crank case, and so to an ordinary marine type of guide shoe, working in a single bar guide carried in the cast frame, which forms the back of the crank case and the support for the cylinders. Narrow portable cast iron T-shaped columns are also fitted in front as additional struts to the cylinders, and to form supports for the large oil-containing wrought iron doors, which are fitted right across the front of the engine and the cast iron ends. Forked connecting-rods of ordinary marine type are fitted to the six-throw crank shaft, the three forward throws of which are arranged at 120 degrees, the three after ones dividing up these angles, so that the order of firing is 1, 4, 2, 5, 3, 6.

"Coming down to the footplate, the various control levers are arranged exactly with the appearance of a steam engine. In the middle is the reversing wheel, with its axis inclined upwards through a worm and quadrant to what we have called the weigh shaft, with to the back of the engine, and connected its pointer indicating the position of the 'links.' To the left is the throttle valve acting on the fuel. To the right are the levers which control the position of the compressed air and fuel valve rockers, and below these is the valve for shutting off the compressed air for spraying the fuel. Still confining ourselves to the description of the mechanical features to be seen, and omitting for the present all discussion as to principles and methods of operation, we find at the after end of the engine the two eccentrics for driving the 'valve gear' and the fuel pump with its gear. In this engine there are only two fuel pumps instead of one to each cylinder, as is usual. The pumps are horizontal, and are driven by a link off one of the coupling rods. One pump is used as a fuel pressure pump for injecting the oil into the cylinders; the other is a stand-by. Attached to the discharge pipe of the pump is a cleverly designed balance gear, consisting of a ram upon which the oil pressure acts, working against a ram of slightly larger diameter acted upon by the high-pressure air, and so arranged that when the oil pressure exceeds the air pressure by the predetermined amount, the rams descend and lift the suction valve of the pump until such time as the pressure has fallen again. Aft of the eccentrics come five ordinary horseshoe thrust collars and a 6-foot diameter fly-wheel.

"Coming round to the back of the engine, there are to be seen the three-stage air compressors, the first stage being a single water-jacketed cylinder driven by links and rockers off one crosshead, the second and third-stage compressors being contained in a single casting driven off a different crosshead, with coolers fitted between Nos. 1 and 2 and again between Nos. 2 and 3. Below the first-stage air compressor are the two water pumps—one for the cylinder cooling water and the other for bilge or deck purposes.

"In the wings on the port side is a two-cylinder 40-50 horse-power Diesel engine of the ordinary type, driving a special two-stage air compressor for

filling the air tanks for starting and manœuvring the main engines, and having also a pulley at the forward end driving by means of a belt a specially designed centrifugal pump for discharging the cargo. In the starboard wings are four compressed air tanks of very large capacity for starting purposes, and holding air compressed to a pressure of 300 pounds per square inch. . . .

"The only other auxiliary in the engine-room is a 10 horse-power two-cylinder electric-lighting Deutz motor, and a remarkable contrast is thus afforded with the usual steam engine-room, with the feed pump, evaporators, condensers, etc., accounting in some degree for the fact that only four hands are carried on the engine-room staff. On deck there are four 4½ inches by 8 inches ordinary steam pattern cargo winches, together with a windlass worked by compressed air with a pressure of 60 pounds to 80 pounds, obtained from the tanks through a reducing valve.

"It may here be stated that no attempt at weight cutting has been made in this endeavor to produce a really satisfactory marine internal-combustion engine, the engine itself weighing 42 tons, and the whole machinery, including pipes, complete, amounting to 85 tons. The height of the engine from the centre of the crank shaft is just over 12 feet, and the length just over 25 feet. The fuel used is Tarakan crude oil, a Borneo product with a specific gravity of .950 at 15 degrees C., which costs 38s. per ton, and of this the guaranteed consumption is .42 pound per brake horse-power per hour at full speed; .44 pound at three-quarter speed; and .5 pound at half speed — a truly remarkable performance."

It will be noticed that the whole engine has been designed to follow, as far as possible, ordinary steam-engine practice—to have easily adjustable parts, to be easily accessible for examination of vital parts, to have parts which can be easily replaced in out of the way corners of the world, and to have the parts so substantially constructed that they shall not be liable to derangement. The builders have employed an ordinary short piston, with a piston rod and slipper guide, and they have used the familiar type of marine connecting rod. Furthermore, the handling of the engines bears a close resemblance to the handling of the steam engine. This close adherence to the normal design of steam marine engines is mentioned with unqualified approval both in the articles descriptive of the *Vulcanus*, and in an editorial in *The Engineer* for January 13. To quote from the latter: "In the course of time, as a new race of sea-going engineers spring up, we shall no doubt see the marine oil or gas engine developing characteristics of its own; but until then there can be no question of the wisdom of introducing the new thing with as little variation from the old and familiar as possible. Step by step desirable changes may be effected, but to throw them all at once before the engineer would be to court prejudice and trouble."

THE FIELDS FOR JET AND SURFACE CONDENSERS.

THE FIELD IN WHICH EACH TYPE MAY BE PROFITABLY EMPLOYED IN CONNECTION WITH HIGH- OR LOW-PRESSURE STEAM TURBINES.

R. M. Neilson—The Engineer.

WE have already published in these columns abstracts of two of the highly practical papers on the economic aspects of surface-condenser design contributed by R. M. Neilson to *The Engineer* at intervals during the last few months. In September last we dealt with the effect of the outlet temperature of the circulating water on the quantity of water required, and in December with the relation of the velocity of the circulating water to condenser-plant economy. In the following pages we present in abstract Mr. Neilson's latest contribution to condenser literature, which appeared in *The Engineer* for December 23, 1910. It is intended to indicate the fields in

which surface condensers and barometric jet condensers may profitably be employed, in conjunction with steam turbines using either high- or low-pressure steam, in those cases in which the choice of the one or the other type is not imperatively demanded by the special conditions.

Many cases arise in which there can be little doubt as to the better system to adopt. For example, if plenty of condenser water is available, but the water is not suitable for boiler feed, it is advisable to employ surface condensers. In cases where the water is too bad, not only for use in boilers but also for use in surface condensers, though usable in jet condensers, the conditions, of course, demand the choice of condensers of the latter type. The more difficult cases may be divided into two classes: first, those in which a plentiful supply of water, usable both in boilers and in surface condensers, is available; and second, those in which water suitable for use both in surface condensers and in boilers is available only in small quantity or at a high price. In both cases either jet or surface condensers may be employed, the second class involving the use of a cooling tower or some other water-cooling arrangement.

While jet-condensing plant involving the employment of barometric water-discharge pipe costs less than surface-condensing plant to maintain the same vacuum under the same conditions, more power is required to drive the air pump in the jet-condensing system on account of the air admitted to the condenser with the condensing water. Water in motion in contact with the atmosphere often contains over 3 per cent. of air by volume, and sometimes over 4 per cent. The air admitted to a jet condenser with the condensing water is usually of more importance in turbine plants than in plants driven by piston engines. Turbine plants usually require higher condenser vacua and employ a greater ratio of condensing water to steam for the same admission temperature of the circulating water. Further, if care is taken in the operation of turbines, very little air should be admitted to the condenser with the exhaust steam. Unless there is direct leakage to the condenser, this small amount of air is all that gains access to surface condensers, while jet condensers receive in addition the air carried by the condensing water. Hence the ratio between the air-pump power required respectively in the jet system and in the surface-condensing system is usually much greater when the two systems are compared for turbine plants than when the comparison is made for piston engines.

The difference in pressure between the condenser and the exhaust end of the turbine is a most important factor in condenser-plant costs. A certain difference in pressure is necessary in order that a flow of steam may take place, but it is worth while going to some trouble and expense to prevent the difference from reaching a high value. It is usually possible to obtain a short and direct connection between a surface condenser and the turbine which exhausts into it, and thus to reduce the difference in pressure between turbine exhaust and condenser to an almost negligible value. With a barometric jet condenser, on the other hand, the necessity of drawing the wet steam through a long exhaust pipe, which usually contains two bends and in the lower part of which water is likely to collect, tends to produce a considerable drop of pressure between the turbine and the condenser. It is, therefore, necessary to design a barometric jet condenser for a higher vacuum than would be necessary with surface-condensing plant to maintain the same terminal pressure at the turbine.

The barometric jet condenser, however, requires less power for pumping the condensing water than the surface condenser. This is due to the fact that the vacuum in the jet condenser can be employed at least to assist in drawing the condensing water into the condenser, while the water is discharged by gravity. In the surface condenser a certain frictional head has to be overcome. The jet condenser loses a part of this advantage when a cooling tower is employed. It is usually expedient then to employ two condensing-water pumps, one delivering to the condenser

and the other to the cooling tower. In the case of a surface condenser, one pump can perform both functions.

In order to ascertain which plant it is best to employ in any non-obvious case, it is necessary to compare the capital outlay with the running costs. The relative importance of first cost to operating cost decreases as the load factor increases. Mr. Neilson investigates the case of condensing plant for a 3,000-kilowatt turbine. The fixed annual costs, which are proportional to the capital outlay and are independent of the load factor, are taken at 15 per cent. for surface condensers and 13½ per cent. for barometric jet condensers, a cooling tower being included in each case. When a cooling tower is not employed, the corresponding figures are 13 per cent. and 11 per cent. The annual running costs, which are proportional to the load factor or to the number of working hours in the year, differ chiefly in the item of power required to run the air pump. The cost of this power, with incidental expenses, has been taken at 0.6d. per effective horse-power hour.

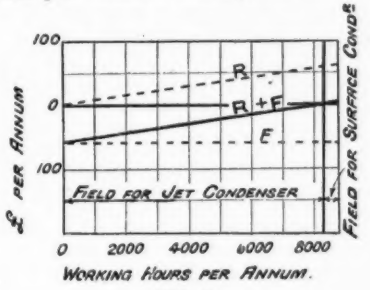


FIG. I.

Figure 1 represents a case where a cooling tower is employed and a turbine terminal pressure of 2 pounds per square inch is desired. The natural-draft cooling tower is capable of reducing the temperature of the condensing water to 82 degrees F. The cost of the surface-condensing plant, including the cooling tower, is estimated at £3,860. In estimating the cost of the jet condenser, the condenser pressure is assumed to be 0.13 pound per square inch less than that at the exhaust end of the turbine. On this assumption, the cost of the jet-condenser plant works out to £3,710. The ordinates in the figures represent annual costs, distances below the zero line being in favor of the jet condenser and distances above the line in favor of the surface condenser. The actual costs are not indicated on the diagrams, but only the differences between the costs for the rival plants. In Figure 1 the line F represents the difference between the fixed annual costs, which for the case under consideration is £79 in favor of the jet plant.

Curve R in Figure 1 represents the difference in running costs for any number of working hours per year from nothing up to 8,760, which represents continuous working. In calculating this curve, the air pump of the jet-condenser plant is estimated to require 14.13 horse power, costing 8.5d. per hour at full load. The corresponding figures for the surface-condenser plant are estimated at 7.76 horse power and 4.7d. per hour, making a difference in cost in favor of the surface-condenser plant of 3.8d. per hour at full load. The cost of driving the water pumps is assumed to be the same in both cases. The line R+F represents the algebraic sum of the ordinates of the lines R and F and shows the net difference in annual cost of the two systems for any number of working hours per year. It will be seen that the jet condenser has the advantage up to 4,989 hours per annum, after which it is superseded by the surface condenser. Hence, when the working hours are less than about 5,000 per year at full load it is advantageous to employ a jet condenser, but when the full power is carried for more than 5,000 hours per year, a surface condenser is better.

Figure 1, then, shows that with a terminal pressure at the turbine of 2 pounds per square inch and with employment of a cooling tower, fields of considerable extent are open to both the jet and the surface condenser. For terminal pressures greater than 2 pounds per square inch the field for the jet condenser is enlarged. Terminal pressures above 2 pounds, however, are seldom desirable for steam turbines. For terminal pressures much lower than 2 pounds the jet condenser has a very limited field. Figure 2 represents the

case of a plant designed for a terminal pressure of 1.5 pounds per square inch, a cooling tower being employed as before. The costs of the surface-condenser and jet-condenser plants are estimated at, respectively, £4,320 and £4,150. The difference in the fixed annual costs is, therefore, £88 in favor of the jet condenser. The working costs are higher in this case than in the case of Figure 1. This is particularly true of the jet condenser, which suffers not only from the greater specific volume of the air due to the lower pressure, but also to the greater weight of air admitted to the condenser in the condensing water. The air-pump power costs of the jet-condenser and surface-condenser installations in this case are estimated at, respectively, 26.8 and 10.9 horse power, the hourly costs at full load at 16.1d. and 6.1d., and the difference in running costs per hour at full load at 10d. It is apparent from the diagram that the jet plant has the advantage only if the plant is worked per annum an amount equivalent to less than 2,112 hours at full load.

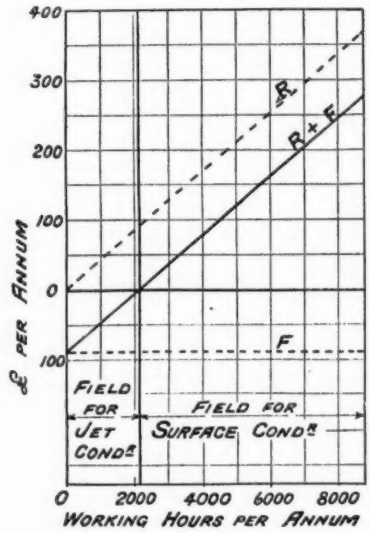


FIG. 2.

Figures 3 and 4 represent cases where no cooling tower is employed and where condensing water can be obtained at a temperature of 60 degrees F. The smaller amount of condensing water required in such cases enlarges the field for the jet condenser, so that for a terminal pressure of 1.5 pounds per square inch, as shown in Figure 3,

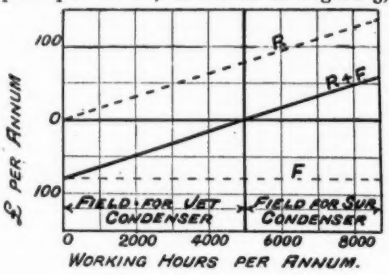


FIG. 3.

the jet condenser has the advantage for practically any number of working hours per year. In this case the surface plant is estimated to cost £1,620, and the jet plant £1,380, the annual fixed costs in favor of the jet plant being £59. The air pump of the jet plant is estimated to require 15.7 horse power and to cost 9.4d. per hour at full load, while the corresponding figures for the surface plant are 10 horse power and 6d. In this case, however, water pumping costs 1.7d. per hour more in the surface than in the jet plant, so that the difference between the running costs is 1.7d. per hour at full load in favor of the surface plant.

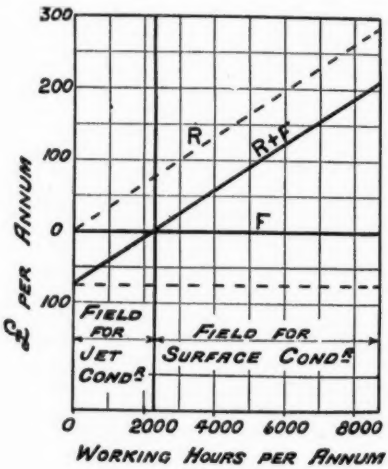


FIG. 4.

At terminal pressures greater than 1.5 pounds per square inch the jet con-

denser will obviously have the whole field to itself. Figure 4 represents a case in which a terminal pressure of 1 pound is required. The surface plant is estimated to cost £2,085 and the jet plant £1,800. The difference in fixed annual cost is £73 in favor of the jet plant. The air pump of the jet plant is estimated to require 28.4 horse power and to cost 17d. per hour at full load. The corresponding figures for the surface plant are 11.4 horse power and 6.8d. Allowing for a difference of 2.4d. per hour in the cost of water pumping in favor of the jet plant, the difference in running costs is 7.8d. per hour in favor of the surface plant. In comparison with the case illustrated in Figure 3, the jet plant has in this case a very limited field—only up to 2,246 hours per year—and for terminal pressures lower than 1 pound per square inch the field of the jet condenser would be still further restricted.

THE PREVENTION OF INDUSTRIAL ACCIDENTS.

A SUMMARY OF THE MOST PROLIFIC CAUSES, AND OF THE MEANS BY WHICH THE MECHANICAL ENGINEER CAN CONTRIBUTE TO THEIR PREVENTION.

John Calder—American Society of Mechanical Engineers.

INDUSTRIAL accidents in the United States take an annual toll of life and limb far exceeding the killed and wounded of several great military campaigns. The incomplete statistics published by the Bureau of Labor in the report for 1908 show that among adult wage earners alone the annual mortality from accident is between 30,000 and 35,000. In the opinion of John Calder, whose paper, "The Mechanical Engineer and the Prevention of Accidents," read at the February meeting of the American Society of Mechanical Engineers, is abstracted below, the non-fatal injuries can not be much less than 2,000,000. The remedy, says Mr. Calder, lies not in legislation, but largely in the hands of the mechanical-engineering profession, who have to deal so largely with the planning and working of industrial machinery. By no means all accidents are preventable, either by employer or employee, but if mechanical engineers will exercise proper supervision and precautions in all plants and industrial processes, and will endeavor to educate operatives in habits of care, at least one-third of the present sacrifice of life and limb can be prevented.

Mr. Calder defines an industrial accident as "any unforeseen and usually sudden occurrence which results in bodily injury to any person while present at the work place or even within the boundaries of the employer's premises." The injury, to be reportable as an accident, need not arise out of or in conjunction with the employee's assigned duties. It is the fact of injury, not the cause, which generally makes an accident reportable under the labor laws to the civil authorities. In some cases a time limit of absence from work due to accident has been fixed by statute to eliminate trivial injuries from reports, but the legislative tendency in all countries now is to call for the report of every injury without regard to its extent or the incapacity for work entailed.

From his analysis of industrial accidents, Mr. Calder has found the chief causes to be ignorance, carelessness, unsuitable clothing, insufficient lighting, dirty and obstructed work places, defects of machinery and structures, and absence of safeguards. Fire, steam generators, electricity, railroads and elevators are omitted from consideration, because to these industrial dangers, chiefly because property as well as persons is involved, engineers have already given considerable attention.

"Accidents due to the culpable as well as excusable ignorance of supervisors, engineers, millwrights, elevator men, firemen, and guardians of general facilities are frequently very serious, and nothing but administrative vigilance in selecting and instructing these employees for their own special risks will suffice to prevent such occurrences. . . . Sometimes combined with ignorance, sometimes sheer thoughtlessness, folly or horseplay, carelessness by operatives

stands highest as a cause of industrial accident from the results of which nothing external can do much to shield the worker and those which he sometimes involves. . . . The maintenance of strict discipline in the shops, the adoption of salutary punitive measures and the firm elimination of the dangerous employee is all that can be done, in addition to a campaign of education throughout the plant."

The ragged sleeve ends, loose ties and open jackets of untidy operators are responsible for many accidents at machine parts which are necessarily exposed. The large extent to which females are employed in light repetition machine work calls for special precautions regarding dress and general tidiness.

Insufficient lighting is a cause of numerous accidents, particularly serious and fatal falls. Mr. Calder has found that the number of accidents is a maximum in the months of minimum daylight. The influence of the duration and intensity of natural light in working hours on the number of accidents is particularly noticeable in the case of foundries, steel works, etc., where the operations are carried on in large spaces which are difficult to illuminate artificially. The practice of concentrating intense illumination on limited areas, leaving the other parts of the plants in semi-darkness, is to be condemned, as both dangerous and unhygienic. A more generally diffused light of less unit intensity is now easily obtained by the use of fewer but larger screened units experimentally located to suit varying shop requirements and reflecting from whitened walls and ceiling surfaces. Closely allied to defective illumination as a cause of accidents are dirty and obstructed work places. Through poor lighting, untidy habits of employees, or crowding of machines, industrial plants often retain dirty and obstructed places which cause stumbling, falls and similar accidents, and every management should see to it that the cleaning of floors and passages and the removal of wastes is systematically provided for.

Defects in machinery and structures are responsible for some accidents, but not for as many as are commonly supposed. It is, however, not unusual to find workmen, even when the best materials and apparatus are available, showing disregard for their own safety and that of others, especially in framing structures of a temporary nature. Workmen of this type should be eliminated as unfit and dangerous, and the ability of any untried operative to construct safe facilities for himself and others should never be taken on trust. Besides, overloaded machines and structures, decayed gangways, worn-out floors and stair treads, unannealed chains and hooks, frayed and stranded ropes and tackle and a host of minor items of industrial equipment should be subjected to systematic and intelligent review.

The absence of safeguards, though not the most prolific cause of accidents, closely concerns the mechanical engineer. Lack of efficient supervision often renders ineffective such safeguards as are provided. The safety engineering of no plant should be left to the haphazard initiative of a number of individuals.

The mechanical engineer may contribute to industrial safety in two ways: first, by the safeguards which he may design as an integral part of the machine tools and other apparatus supplied by him for use in the arts; and, second, by the safeguards which he may later devise and supply as the engineer or executive of plants using power apparatus and other equipment capable of inflicting injury as installed, and which cannot be intelligently protected until all related apparatus is in position and the operating conditions for employees fully apparent.

Machine-tool builders have already accomplished a great deal in the safeguarding of machinery, particularly in the protection of toothed gears in metal-working and other tools, although Mr. Calder gives an example of a so-called guard which is in reality a snare. Shafts and spindles, low pulleys, belts, intaking sides of gears, narrow clearances between fixed and moving parts, couplings, projecting screws, nuts and pins and numerous similar risks on moving parts of machines as designed are best handled for protection by the machine builder, and Mr. Calder gives a number of illus-

trations of what machine builders are now doing for the protection of workmen against risks of this character. He also illustrates methods of safeguarding equipment built into position, which includes power generators and a very large class of machines and industrial apparatus whose accident risks at dangerous parts depend upon the environment, the manner of installation and the precise nature of the workmen's duty around them. "Protection against accident at such apparatus is not secured, as is sometimes supposed, by guarding merely the dangerous moving parts. All stationary portions of such prime-mover structures as may cause injury to attendants and others should be equally included in the scheme of protection. In power houses the edges of all stairs, platforms, ladders and gratings should have low fenders of metal on both sides which will prevent nuts, bolts, tools, and other small parts rolling off into the machinery or striking employees in their fall. . . . Engine attendants have necessarily to operate often where the footing is slippery and insecure, and should be safeguarded when reaching out to bearings close to crank pits and other parts, or in passing around tail rods and under low fly balls and other similar parts which can and do cause many serious and not a few fatal injuries, particularly on the older prime movers still in service." To the guarding of transmission machinery also Mr. Calder devotes a good deal of attention, and illustrates guards for shafting, bearings and pulleys, desirable types of shaft couplings, collars and set screws for transmission apparatus, and safe belt replacement poles.

The most difficult safeguarding problems for the engineer are those relating to the numerous machines which are essentially dangerous at the operating point. No such machine is effectively protected by any guard which hampers a workman, reduces his speed and earnings or has not been designed for the actual working conditions. Mr. Calder illustrates the problem of the especially dangerous machine by means of four examples, probably the most prolific in accident to the operator when performing his usual duties. These are woodworking saws and cutters, punches and presses, rolling machinery of all kinds where hand feeding is necessary, and emery and other grinding wheels. Mr. Calder gives many illustrations of safeguards for machines of these classes, to show that they are all capable of efficient protection.

"The installation of machinery in relation to walls, passages, and adjacent tools and equipment deserves careful consideration. In any confined space over which any person is liable to pass and towards which the carriage of any self-acting or automatic reciprocating machine runs out, there should be left a clear 18-inch passageway between the carriage when fully out and the wall or other fixed structure not part of the machine. Danger due to position also arises in connection with limited clearance between other travelling or reciprocating machine parts and walls and fixed structures, as well as at the openings in the fixed machine framing which they pass. . . . Where the speed of the fixed reciprocating part is considerable, and a blow rather than a gentle push would be caused by accidental contract with it, the path of the piece should be screened off permanently at the extreme end of its maximum working stroke."

The most serious injuries in connection with fixed structures inside plants occur in chemical and other works where large open receptacles for stock at a high temperature or chemically dangerous are in common use, and the processes are necessarily continued day and night. Mr. Calder has found the best arrangement in such cases to be that where the top 3 feet of the vat or tank is used as a guard or fender, and the working platform is this distance below the edge or lip of the dangerous vessel. Gangways over tanks and vats should be double railed on each side and their efficient maintenance closely watched. It is also well to round off the edges of open tanks or vessels, so that they offer no foothold.

"Safeguards, where at all possible, should be constructed of metal to secure durability. Reinforced steel mesh work is to be preferred for all but the heaviest

machinery. It is superior to guards of opaque material since it permits easy inspection without detaching the safeguard and interferes as little as possible with lighting conditions. In steel mills, foundries and heavy work plants of various descriptions, where the wear and tear of equipment is very great, nothing but strong castings or steel plate work should be used for the majority of the guards."

Warning and caution notices should be sparingly used and should be as brief as possible. They are practically worthless if no attempt is made to enforce them. The efforts of well instructed and sympathetic foremen receiving full credit for the safe working of their departments, and a few well considered and enforced regulations prominently displayed in print are far more effective than a long catalogue of works rules which few will read and none will remember.

Mr. Calder recommends the provision in every works of facilities for giving first-aid service within the plant to every injured person. He also suggests, in conclusion, that "every works executive and engineer will find it a valuable adjunct to the safety engineering of the plant to maintain in every department, apart from labor law and casualty insurance reports, a full and accurate record of every accident and also of every near accident. Periodical examination of these and the determination of every mechanical engineer to practice safety engineering to the best of his ability, without regard to the legal minimum or compulsion, will help more than anything else to remove a great reproach from our industrial life."

CASTINGS TO WITHSTAND HIGH PRESSURES.

AN INVESTIGATION OF THE PRODUCTION OF CASTINGS OF NON-FERROUS ALLOYS TO WITHSTAND HIGH HYDRAULIC OR GASEOUS PRESSURES.

H. C. Carpenter and C. A. Edwards—Institution of Mechanical Engineers.

FOR over three years Prof. H. C. H. Carpenter and C. A. Edwards have been engaged in an investigation of the production of castings of non-ferrous alloys capable of withstanding high hydraulic or gaseous pressures, such as are used for high-pressure pumps, steam valves, gun mountings, and many other purposes. Hitherto it has been possible to obtain sound castings for pressures up to 20 tons per square inch without resort to some type of steel, which is unsuitable for the purposes mentioned on account of its corrodibility, but without any degree of regularity. The results of this investigation, briefly summarized below after a long report presented to the Institution of Mechanical Engineers on December 16 last, establishes a sound scientific basis for the production of high-pressure castings of non-ferrous materials.

The authors introduce their report of the investigation with a short *résumé* of the principal materials used in present practice, and of the practical difficulties which have to be overcome in the production of sound castings. The alloys in current use fall into two main classes. Either they are gun metals with copper and tin as their principal constituents, or they are complex brasses with copper and zinc as their principal constituents. The former usually contain zinc, and may also contain lead and manganese; the latter ("manganese bronzes") contain iron, manganese, tin, and in some cases aluminium among their minor constituents. The difficulties in casting may be summarized under three main heads: first, those liable to be caused by the metal or alloy, which include (1) dross or scum, due to oxidation; (2) piping, due to shrinkage of the fluid metal; (3) sponginess, due to the trapping of gas; (4) heterogeneity, due to segregation; (5) stresses, set up in the solid alloy by unequal contraction; (6) deterioration, due to structural or molecular changes in the alloy with lapse of time; second, those liable to be caused by the pattern, which include (1) stresses, set up during cooling by abrupt changes in thickness of section; and (2) planes of weakness, caused by crystals growing in a particular direction; and third, those liable to be caused by the mould, limited to blow holes caused by the mould being too

hard or too damp, or to the sand containing rust or scale.

The properties desired in the castings were: mechanical strength, including rigidity and ductility; homogeneity; soundness; freedom from liability to deterioration; and minimum corrodibility in fresh and sea water. The method adopted by the authors was to start with the simplest case possible and to work out the conditions for success, bearing in mind the limitations imposed by practice; having achieved this, to introduce one variable or complication at a time, and to work out the conditions for its success, before proceeding to the next. In the tests, the castings were machined, and if they appeared clean and sound, a valve was fitted into them. The pressure was first taken up to 4 tons; castings which held this without the least sign of leakage for twenty-four hours were then tested on a high-pressure hydraulic pump, capable of raising the pressure to 20 tons. All the castings which passed the preliminary tests were tested at pressures varying from 14 to 20 tons.

The authors first attacked the problem of selecting a suitable material for high-pressure castings, and experimented with cylinders of pure gun metal, cast in chill moulds and machined to 5¾ by 2¼ inches, the bore and thickness of wall being each ¾ inch. The material contained only copper and tin, in the proportion of 85 to 15, with a little phosphorus, not over 0.1 per cent. in the cast alloy, added to remove oxygen. Castings were repeatedly produced which were perfectly sound, and after machining withstood pressures averaging 18 tons before they burst. So far as chill casts were concerned, this pure gun metal, *when freshly cast*, gave quite satisfactory results. Castings made in sand moulds were less satisfactory; in no case could the pressure be taken above 7 tons. Finally the authors abandoned their experiments with gun metal when they learned that alloys of this composition deteriorate with lapse of time.

They next turned their attention to the aluminium bronzes, which they had already investigated for the Alloys Research Committee. These alloys offered the advantages of homogeneity; considerable tenacity and ductility, the former rising and the latter falling as the aluminium is increased; ease of preparation; and very slight corrodibility. Tests on 9 per cent. aluminium bronze showed that it is possible to cast cylinders of this material both in chill and in sand moulds, which are not burst by water pressures of 18 tons per square inch. Their only drawback was that they began stretching at pressures of 10 to 12 tons, the sand castings giving the lower figure. Accordingly the authors experimented with stiffer materials produced by increasing the percentage of aluminium in the bronze. Alloys containing up to 11 per cent. of aluminium were tested. Up to 10 per cent. it is practically impossible to break a sound casting by hydraulic pressure, owing to the gradual stretch of the material. The most serviceable bronzes under this test are those containing from 10.5 to 11 per cent. of aluminium. They are stiff and tough alloys and break with considerable extension.

Alloys of suitable composition having been found, the authors turned their attention to the casting of the aluminium bronzes in more complicated forms. The type chosen was a hydraulic valve block. The first castings were rendered useless by the formation of dross, and efforts were made to clean the metal by the use of deoxidizing agents. Still, the formation of dross persisted, and the authors were led to the conclusion that the dross was in some way formed inside the mould. It was finally discovered that the dross was caused by the formation of large amounts of alumina when the metal was poured so as to cause agitation sufficient to break the skin of alumina formed as soon as the metal reached the mould. A complete remedy was found in pouring the aluminium bronzes as quietly as possible and in preventing any agitation in the metal after it had reached the mould.

Summing up the results of this investigation, "the conditions have been worked out under which non-ferrous hydraulic castings, capable of withstanding pressures varying from 14 to 20 tons, can be produced. Castings of the same

composition will be capable of holding gas pressures of 2,000 to 3,000 atmospheres at the ordinary temperature. These results have been obtained by the use of pure copper-aluminium bronzes containing from 9 to 11 per cent. of aluminium, according to the size and shape of the casting, and permitting considerable latitude as regards the degree of 'stiffness" required. The largest casting experimented with weighed 36 pounds, including the gate and riser. The most suitable compositions for these are the bronzes containing from 9 to 10 per cent. of aluminium. Higher percentages can be employed only with small castings.

"The following precautions have been found essential:—

(1) The alloy must be poured very slowly.

(2) It should be cast at a temperature of not more than 50 to 80 degrees C. above that at which freezing begins.

(3) The gate should be so arranged that the metal enters the mould at the lowest possible point. Broadly speaking, almost any form of gate will do, but it has been found advantageous to provide a sort of well at the bottom of the mould and to use a rather narrow opening for the entrance of the metal.

(4) In the case of green-sand moulds, care must be taken that the sand is not too damp, particularly in the lower parts where the metal rests on it. If a rather close sand is used it is far safer to dry the surface of the lower part of the mould.

(5) In large castings the use of risers is essential to overcome the shrinkage of the alloy.

"If these conditions are observed, after sufficient practice, castings can be regularly made that are absolutely free from dross and nearly always sound. The average is not less than four clean, sound castings out of six."

RAILWAY COLLISIONS IN THE UNITED STATES.

LACK OF DISCIPLINE AS AN IMPORTANT CAUSE, AND THE POSSIBILITY OF REDUCING THE NUMBER OF ACCIDENTS BY THE INTRODUCTION OF AUTOMATIC TRAIN-STOP DEVICES.

Report of the Block-Signal and Train-Control Board.

SINCE the preparation of our review in the last issue of THE ENGINEERING MAGAZINE of M. Hoogen's summary of the results of the trials on German railways of devices for the prevention of overrunning of signals set at "danger," the third annual report of the United States Block-Signal and Train-Control Board to the Interstate Commerce Commission has been made public. A large part of the report deals with the automatic-stop devices submitted to the Board for investigation. These devices are based, in the main, on the same principles as the devices investigated in Germany, and the experience of the Board has been similar to that of the German railways. Of the 149 signal and automatic train-stop devices submitted to the Board, only 16 have been considered of sufficient merit to warrant extended tests. Two mechanical trip devices have given results which indicate that their use would materially promote safety in railway operation, but the Board consider it improper to make any recommendations concerning the compulsory adoption of automatic train stops based on them alone.

We are not concerned, however, with that part of the report which deals with the various devices investigated by the Board and with their estimate of the practical utility of individual apparatus. The most striking feature of the report is a discussion of the larger aspects of train control by means of automatic-stop devices, and of the superior importance of *personnel* to mechanical devices as factors in the problem of reducing railway collisions. From this part of the report we quote at length:

"Collisions resulting from the weaknesses in the time-interval or train-dispatching system, and the deficiencies in the block system due to untrained or undisciplined signalmen, as well as errors on the part of enginemen and

trainmen, have led to public demand for automatic devices. Many seem to believe that the introduction of the automatic train stop would greatly diminish railroad collisions of all classes.

"While it is true that the use of automatic features in the block system itself, as a result of which block signals are actuated directly by the movements of the train, would greatly diminish the number of collisions due to errors in manual block working, the fact should be clearly borne in mind that the automatic stop corrects but one defect, namely, the failure of the engineman to observe, understand, and obey signal indications. It does not in any way insure that the indications displayed will be correct, nor in any way prevent collisions due to the inherent defects of the dispatching system nor to improper working of the block system.

"This, however, should not be construed as in any way minimizing the importance of the automatic stop, for it is a well-known fact that many accidents have been caused by the failure of enginemen to observe, understand, and obey signal indications. Failures to observe signals may be due to fog, snow, signal light not burning, or smoke from other trains; failure to understand or comprehend the signals may be due to complexity in the system of indications or to diversion of the engineman's attention or to his physical incapacity; failure to obey indications that are seen and comprehended are rare, and comprise only those cases where enginemen desiring to make time are tempted to take chances, or to a too liberal interpretation of rules which allow the enginemen some discretion.

"Experience with automatic stops shows that under proper discipline they perform a moral function in that runners are more careful to heed stop signals when it is certain that disobedience of such signals will be detected. . . . While the Board confidently expects the automatic stop to be developed to a point where, like the block signal, the car coupler, and the train brake, it will be available to railroads generally, and in many situations will constitute one of the factors promoting safety in train operation, the Board is led to believe from its study of existing conditions, particularly as found in connection with the means now employed for the safe movement of trains, that the primary cause of the lamentable record of collisions in this country is of so serious a nature as not to be susceptible to complete cure by any mechanical means. It is not to be considered that the automatic stop, or that any automatic device, will be a panacea for all the faults at present existing in train operation. The question really is whether by the introduction of automatic devices the percentage of accidents due to those faults can be reduced.

"It is an unwelcome thought that the fundamental responsibility for the relatively large number of collisions in this country is chargeable to railroad officers and employees; not to them because they are more careless or less sensible of their responsibilities than men in other vocations, for that cannot be truthfully said, but simply because they possess the qualities, mental or temperamental, which are the cause of these deplorable results, and which are symptomatic of characteristics common to all who have been reared in a new and rapidly developing country. But sober reflection leads inevitably to the conclusion that, outside of the army and navy, the American is not reared with that discipline which becomes a part of the man and governs his actions mechanically, as it were, rather than as the result of reasoning.

"Such discipline leads to action as one's first duty without question or reason, and the sense of duty is the one predominating quality which influences the man's every action unconsciously and unfailingly. This conclusion is brought home all the more convincingly when one reflects that nowhere in the world have appliances for safeguarding railroad transportation been so highly developed as in this country, notwithstanding which nowhere in the world is there a greater proportionate number of accidents of the kind which such advance in the art should prevent. The

automatic stop, therefore, while it might be unnecessary under different social conditions, may be expected to add to safety in train operation under the conditions which do exist and must continue to exist in this country until we shall come to appreciate and realize all that may be accomplished by discipline of the right sort. But mere discipline will not suffice alone. There must go with it the spirit which prompts obedience for the pleasure of being approved by one's own conscience.

"It being admitted that what is most needed is automatic performance of one's duties rather than automatic mechanical devices, how may it soonest be brought about The causes that militate against the development of the human machine to perfection of disciplined action are so complex and so interwoven with our social being that many of them can be eradicated only by that slow evolution or growth which results from the operation of natural laws and which can hardly be forced or even guided by the enactment of man-made statutes.

"Nevertheless a number of these causes appear susceptible of marked and present improvement. Appeals to conscience may develop a high sense of duty in many men, but the ever-present problem of earning a living, by its very insistence, makes the appeal to self-interest powerful and practical. The pension system as in force on a number of prominent roads and as advocated by the board in its report last year is believed to offer a strong inducement to careful conduct and should be encouraged.

"The existence in the regulations of some railroad companies of rules that are unfair or non-enforceable, and intended only as an extreme legal precaution to protect the companies, is nearly as bad in its effect upon discipline as the failure of railroad officers to rigidly enforce those rules which are proper and necessary to safeguard traffic.

"The American Railway Association some years ago prepared, and with painstaking effort has since amended and improved, its standard code of rules governing train operation. It is unable to compel their use or their uniform interpretation and enforcement on individual roads. The causes heretofore mentioned and others affecting discipline have the bad effect of impelling railroad employees to move about from one road to another. This tends to decrease safety in operation by frequently placing men in unfamiliar surroundings; and the condition is made still more undesirable by the lack of uniformity in rules and procedure on different roads.

"A case where, on a single-track railroad 150 miles long, used jointly by the trains of three different companies, a system of whistle signals is used on the trains of one company which is entirely different from that used by the other two, is an aggravated example. Legislation in at least one state requires railroad companies to file copies of their operating rules with the State Railroad Commission, and makes any infraction of the rules by an officer, agent or employee a misdemeanor. From this to a federal requirement of the same nature, and, what is more important, enforcing uniformity, is but a short step and one likely to be advocated in the absence of an improvement in railroad procedure in this respect.

"The law passed by Congress at its last session authorizing the Commission to investigate train accidents, should tend to make for better methods and improvement in *personnel* by directing public attention to those defects and deficiencies which have resulted in train accidents, and thus lead to their correction. But on the theory that prevention is better than cure, it is obviously the part of wisdom to take all practicable measures beforehand to prevent those evils that have heretofore resulted in collisions rather than to wait for the occurrence of accidents to disclose the existence of the evils. Investigations such as the board has been conducting into block-signal and other operating methods, therefore, should be continued and conducted on a larger and more comprehensive scale than has been done in the past. This is necessary, with or without a law requiring the use of the block system."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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CIVIL ENGINEERING

BRIDGES.

Arches.

Work on St. Martin Canal, Paris. Illustrates and describes the method of constructing reinforced concrete vaulting over a distance of 802 ft. 900 w. Sci Am—Dec. 31, 1910. No. 19786.

The Design of Two Arches Supported by One Pier (Beitrag zur Berechnung von Gewölben mit Zwischenpfeilern). Robert Otzen. Mathematical. Ills. 2400 w. Deutsche Bau—Dec. 21, 1910. No. 20461 B.

Cantilever.

The Pittsburgh & Lake Erie Cantilever Bridge Over the Ohio River at Beaver. Illustrated detailed description of the bridge and its construction. 10800 w. Eng Rec—Jan. 28, 1911. No. 20646.

The Pittsburgh & Lake Erie Cantilever Bridge Over the Ohio River at Beaver, Pa. Illustrated detailed description of this new double-track through-truss bridge of the three-span cantilever type. Plate. 6000 w. Eng News—Jan. 26, 1911. No. 20615.

We supply copies of these articles. See page 1022.

Concrete.

A Heavy Concrete Bridge Built to Resist Ice Pressure. Mason D. Pratt. Illustrated description of a concrete arch bridge with concrete filling and spandrel walls, crossing Swatara Creek at Hummelstown, Pa. 500 w. Eng News—Jan. 26, 1911. No. 20620.

Design.

Deduction of a New Rational Formula for the Most Economic Length of Each of a Series of Bridge Spans. Considers not only first cost, but maintenance and depreciation. 2500 w. Engng-Con—Jan. 4, 1911. No. 20059.

Equivalent Loading in the Design of Highway Bridges (Ersatzlasten zur Berechnung der Hauptträger von Strassenbrücken). Johann Lipold. Mathematical, with tabular numerical data. Ills. 4200 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 17, 1910. No. 20484 D.

Erection.

Incidents in the Construction of the Miles Glacier Bridge. Illustrated article describing some of the difficulties encountered on this unusual work. 2500 w. Eng Rec—Dec. 31, 1910. No. 19868.

Highway Bridges.

Relation of Bridge Specifications to Highway Improvement. Albert Smith. Read before the Indiana Engng Soc. A criticism of the practice of building new bridges which are unsafe for roadmaking machinery. 1500 w. Eng Rec—Jan. 21, 1911. No. 20345

Indianapolis.

The White River Bridges in Indianapolis, Ind. Illustrates and describes recent bridges built to carry the highways over this river which intersects the city, showing the tendency toward beauty of design. 1600 w. Munic Engng—Jan., 1911. No. 20332 C.

Piers.

Enlarging the Lachine Bridge Piers. Illustrated description of methods of reconstruction used for a bridge across the St. Lawrence River, near Montreal. 1800 w. Eng Rec—Jan. 21, 1911. No. 20346.

Reinforced Concrete.

The French Broad River Bridge, Southern Railway. Illustrates and describes a reinforced concrete girder bridge 733 ft. 10 ins. long, the approximate cost is given as $125,000. 1000 w. Eng Rec—Jan. 7, 1911. No. 20004.

Canal Bridges (Kanalbrücken). F. Steinleitner. Describes three short reinforced-concrete girder spans. Ills. Serial. 1st part. 2800 w. Beton u Eisen—Dec. 14, 1910. No. 20486 F.

Design of an Arch Bridge in Hollow Reinforced Concrete Blocks (Entwurf einer gewölbten Brücke aus bewehrten Betonhohlblöcken über die "Gula" km 431.9 der Linie Christiania-Drontheim). Jens G. F. Lund. Brief description of the materials and erection. Ills. 4000 w. Beton u Eisen—Dec. 14, 1910. No. 20489 F.

Steel.

The New Kentucky River High Bridge. Illustrated description of the new double-track structure now being erected to replace single track long span cantilever bridge. 1800 w. Eng Rec—Dec. 31, 1910. No. 19872.

Suspension.

The Stiffened Suspension Bridge Applied to a Short Span. Frank Barber. Illustrated description of a bridge over the River Don, Oriole, Ont., having a span of 90 ft., a roadway of 14 ft., and the floor 15 ft. from low water. 1500 w. Can Engr—Jan. 12, 1911. No. 20207.

Viaducts.

The Middlesex Falls Concrete Viaduct. Illustrated description of a reinforced-concrete viaduct near Boston. 1000 w. Eng Rec—Jan. 21, 1911. No. 20343.

The Erection of the Shepherdstown Viaduct. Illustrated description of methods of erection of this viaduct in W. Va. A steel cantilever traveler was used. 1500 w. Eng Rec—Dec. 31, 1910. No. 19875.

The Reconstruction of the Radcliffe Viaduct. Illustrates and describes details of the old and new Radcliffe viaducts on the Nottingham and Grantham branch of the Great Northern Railway. The old viaduct was timber; the new is constructed in brick work. 900 w. Engr, Lond—Dec. 30, 1910. No. 20098 A.

New Street Viaducts at Denver, Colo. Gives drawings and descriptions of viaducts built to carry the streets over the valley of the South Platte River, which passes through the city. 4500 w. Eng News—Jan. 5, 1911. No. 19935.

Winnipeg.

Winnipeg's Bridges. Paul Schioler. Illustrated description of bridges and viaducts across the Red River, Assiniboine River and the railways. 4500 w. Can Engr—Jan. 19, 1911. No. 20379.

CONSTRUCTION.

Columns.

Hooped Columns and the Austrian Regulations (Umschnürte Säulen und die ministeriellen Vorschriften für Oesterreich). Max Gatterer. A mathematical discussion, dealing principally with the Abramoff-Magid system. Ills. 4700 w. Beton u Eisen—Dec. 14, 1910. No. 20487 F.

Concrete.

General Concrete Practice. Thomas Potter. Abstract of a paper read before the Concrete Inst. Deals with the use of concrete in connection with buildings, apart from any association with reinforcement or steel work. 2500 w. Surveyor—Dec. 23, 1910. No. 19967 A.

Method of Designing Concrete for the Sea View Hospital. Brief description of

We supply copies of these articles. See page 1022.

the method of design followed in structures on Staten Island, N. Y. 1200 w. Eng Rec—Jan. 7, 1911. No. 20006.

Method of Finishing Concrete by Rubbing, Floating and Brushing, with Some Costs. S. M. Klein. Describes a method that gave very satisfactory results. 2000 w. Engng-Con—Jan. 11, 1911. No. 20118.

Mixing Concrete on the Farm. Describes how to select the materials and mix the concrete. Ills. 1000 w. Sci Am Sup—Jan. 7, 1911. No. 19945.

Depositing Concrete Under Water in France. Illustrated description of methods employed in repairing the movable dam across the River Saône at Gigny, France, as given by Henri Tavernier, in *Ann. des Ponts et Chaus.* 800 w. Eng Rec—Jan. 7, 1911. No. 20010.

The Exploitation of Concrete (Ausbeute des Betons). M. Marcichowski. A discussion of the principles of concrete mixing. 4900 w. Beton u Eisen—Dec. 14, 1910. No. 20488 F.

Contractors' Plants.

Construction Plant-Layout for a Concrete Building. Illustrates and describes a plant at Chicopee, Mass., used for the building of a 4-story reinforced concrete factory. 1200 w. Eng Rec—Jan. 14, 1911. No. 20184.

Earth Pressures.

Earth Pressures. Charles K. Mohler. A study of theories, showing lack of agreement, and breakdown in the theories when worked out for results; also formulæ and results from a new method. Ills. Discussion. 17000 w. Jour W Soc of Engrs—Dec., 1910. No. 20555 D.

Excavation.

Excavating the Pit for a Third Lock at Sault Ste. Marie. Illustrated description of methods of excavation. 1500 w. Eng Rec—Jan. 7, 1911. No. 20009.

Improvements in Spoil-Handling Plant at Panama. Describes improvements in equipment for the heavy work of handling earth and rock on a very large scale. 1500 w. Eng Rec—Jan. 14, 1911. No. 20177.

Classification of Material in the Transcontinental Railway. Gives the Classification made by the Chief Engineer in preparing the specifications, and opinions in regard to the interpretations. Ills. 3000 w. Can Engr—Jan. 5, 1911. No. 20063.

See also Submarine Excavation under WATERWAYS AND HARBORS.

Failures.

Report of the Commission Appointed to Investigate the Collapse of the Henke Reinforced Concrete Building, Cleveland, O. Also a letter from Edward Godfrey, and editorial note. 4500 w. Eng News—Jan. 26, 1911. No. 20625.

Failure of a Very Large Concrete Oil Reservoir. Illustrations of the two large reservoirs, with a capacity of 1,000,000 bbls. each, built at San Luis, Obispo, Cal., with an account of the failure of one. 600 w. Eng Rec—Jan. 14, 1911. No. 20178.

Fireproofs.

Heavy Truss Work in the Electric Building, Portland, Ore. Cross-section of a nine-story building with description. 1000 w. Eng Rec—Jan. 28, 1911. No. 20649.

Floors.

Warehouse with a New Type of Girderless Floors. Describes a new type of girderless reinforced concrete floors built in a large wool storage warehouse in Boston. 1800 w. Eng Rec—Jan. 14, 1911. No. 20183.

Foundations.

Replacing Foundations of a Steel Bridge Over a Railroad. Illustrates and describes work at Fifty-fourth St. in connection with terminal improvements of the N. Y. C. & H. R. R. R. 1000 w. Eng. Rec—Dec. 31, 1910. No. 19874.

Notable Improvements in Caisson Practice (Bemerkenswerte Neuerungen bei Druckluftgründungen). G. Lüscher. Brief description of new methods of handling materials. Ills. 1800 w. Schweiz Bau—Dec. 3, 1910. No. 20462 B.

Piling.

A Comparison of the Initial Cost of Concrete and Wood Piling. Philip J. Kealy. Analysis showing a saving in cost in favor of concrete. 1800 w. Engng Con—Jan. 25, 1911. No. 20607.

A Discussion of the Carrying Capacity of Bulb-Pointed Concrete Piles. Hunley Abbott. A study of the factors which determine the load which can be transmitted by pile foundations to the subsoil, and the most economical method of increasing this carrying capacity. Ills. 2500 w. Engng-Con—Jan. 11, 1911. No. 20119.

Larssen Sheet Steel Piling (Die eiserne Spundwand von Larssen). J. Wilhelmi. Describes the piling, the method of locking, and some works in which it has been used. Ills. 2800 w. Zeitschr d Ver Deutscher Ing—Dec 10, 1910. No. 20706 D.

Reclamation.

Draining the Everglades. Day Allen Willey. An account of this work in Florida, and the results. Ills. 1600 w. Sci Am—Jan. 21, 1911. No. 20388.

Report on the St. Francis Valley Drainage Project in Northeastern Arkansas. Arthur E. Morgan. Assisted by O. G. Baxter. General report with maps and illustrations. 40500 w. U S Dept of Agri, Bul 230. Serial. Part I—Jan. 20, 1911. No. 20671 N.

A Land Drainage Project Near Louisville, Kentucky. Map and outline of a proposed drainage system to reclaim marshes. 1800 w. Eng News—Jan. 12, 1911. No. 20140.

We supply copies of these articles. See page 1032.

A Preliminary Report on the Drainage of the Fifth Louisiana Levee District, Comprising the Parishes of East Carroll, Madison, Tensas, and Concordia. A. E. Morgan, S. H. McCrory, and L. L. Hidinger. 10500 w. U S Dept of Agri, Circ. 104—Jan. 21, 1911. No. 20674 N.

The Drainage Situation in the Lower Rio Grande Valley, Texas. L. L. Hidinger. Information concerning the drainage, soils, rainfall, alkali, methods of reclamation, etc. Maps. 12600 w. U S Dept of Agri, Circ. 103—Jan. 12, 1911. No. 20673 N.

A Report Upon the Reclamation of the Overflowed Lands in the Marais des Cygnes Valley, Kansas. S. H. McCrory. Assisted by D. L. Yarnell and W. G. McEathron. General description of the watershed, river, floods, etc., with report of investigation made, and plans recommended, the probable cost, etc. Maps. 13000 w. U S Dept of Agri Bul 234—Jan. 14, 1911. No. 20670 N.

Reinforced Concrete.

Possible Defects in Reinforced Concrete and Their Causes (Importanza del Cemento armato nella Esecuzione. Difetti possibili di Questa e Cause relative). Luigi Novelli. Discusses the remarkable extension of the use of this material and the errors to guard against. Serial. 1st part. 3600 w. Il Cemento—Dec. 15, 1910. No. 20442 D.

See also Contractors' Plants, Failures, and Floors, under CONSTRUCTION; and Snow Sheds, under RAILWAY ENGINEERING, PERMANENT WAY AND BUILDINGS.

Roofs.

The Norumbega Park Theater Roof. Plans and description of the roof for an open air theater in Auburndale, Mass. 600 w. Eng Rec—Jan. 14, 1911. No. 20182.

Stacks.

The Monoshaft System of Chimney Construction. J. S. E. De Vesian. From a paper read before the Engng. Soc. of Gloucester. Illustrated description of a durable, cheap and quickly erected factory chimney. 1500 w. Col Guard—Jan. 6, 1911. No. 20259 A.

Steel.

The Curtis Power Building. Describes the power building and equipment which will serve the 12-story Curtis Building now under construction in Philadelphia, Pa. Ills. 2500 w. Eng Rec—Jan. 7, 1911. No. 20007.

The Construction and Mechanical Equipment of the Buildings of the Hamburg Warehousing Company (Die Entwicklung der bau- und maschinentechnischen Anlagen der Hamburger Freihafen-Lagerhaus-Gesellschaft). P. Eilert. The first part describes structural features of the warehouses. Ills. Serial. 1st part. 6400 w. Zeitschr d Ver Deutscher Ing—Dec. 10, 1910. No. 20705 D.

See also Fireproof, under CONSTRUCTION.

Tunnels.

Methods of Constructing the Land Sections of the La Salle Street Tunnel, Chicago. Illustrates and describes the work of construction of the approaches only. 2000 w. Engng-Con—Jan. 11, 1911. No. 20120.

Rebuilding the La Salle St. Tunnel Under the Chicago River. Illustrated description of the methods of construction of steel twin-tube concrete lined tunnels for the Chicago River crossing. 4500 w. Eng News—Jan. 12, 1911. No. 20142.

The Laramie-Poudre Tunnel. Burgis G. Coy. Describes the driving of this tunnel, which forms a part of an irrigation project in Colorado. 4000 w. Eng Rec—Jan. 14, 1911. No. 20179.

The Transandine Summit Tunnel. John Pollock. Illustrates and describes the construction of this tunnel which forms the final link in the chain connecting Chili and Argentine Republic. 4000 w. Engng—Dec. 30, 1910. No. 20091 A.

The Loetschberg Tunnel. E. L. Corthell. Map, profile, illustrations and description of this Alpine tunnel now under construction. 2500 w. Eng News—Jan. 5, 1911. No. 19933.

MATERIALS OF CONSTRUCTION.

Bituminous Materials.

See Roads, under MUNICIPAL.

Concrete.

Tufa Concrete. J. B. Lippincott. Extracts from a paper read before the Nat. Assn. of Cement Users. An account of the use of volcanic tufa in the making of concrete for the Los Angeles Aqueduct. 2500 w. Eng Rec—Dec. 31, 1910. No. 19871.

Tests to Determine the Values of Clay and Reground Cement for Securing Impermeable Concrete. O. L. Huffman and E. S. Fowler. Condensed from Bul. V., Iowa State College Engng. Ex. Station. Investigation of the value of reground cement and clay, as waterproofing materials in cement mortars and concrete. 2000 w. Engng-Con—Jan. 28, 1911. No. 20608.

Paints.

The Value of Certain Paint Oils. Henry A. Gardner. Gives a summary of results obtained from a series of experiments on paint vehicles. 4000 w. Jour Fr Inst—Jan., 1911. No. 20321 D.

Reinforced Concrete.

A Review of the Use of Reinforced Concrete in San Francisco and Vicinity. John B. Leonard. Read before the Nat. Assn. of Cement Users. 2500 w. Cement Age—Jan., 1911. No. 20630.

We supply copies of these articles. See page 1022.

The Effect of Electrolysis on Metal Embedded in Concrete. Cloyd M. Chapman. Read before the Nat. Assn. of Cement Users. Gives data bearing on the destructive action. 2500 w. Engng-Con—Jan. 25, 1911. No. 20609.

Timber.

Utilization of California Eucalypts. H. S. Betts and C. Stowell Smith. Information concerning the tree and its uses, giving results of mechanical tests and information in regard to the uses of eucalyptus wood in California and Australia. Ills. 7000 w. U S Dept of Agri-Circ, 179—Dec. 29, 1910. No. 20312 N.

Timber Preservation.

Marine Wood Destroyers in the Waters of the South Atlantic Ports. W. D. Faucette. Information concerning the various species and their habitat, and methods of protection in use. 2000 w. Eng News—Jan. 5, 1911. No. 19936.

See also Poles, under ELECTRICAL ENGINEERING, TRANSMISSION.

MEASUREMENT.

Stream Gauging.

Experiments on Flow and Measurement of Water. James Barr. Abstract of paper before the Engrs' Club of Toronto. Remarks on the submerged circular orifice, the rectangular notch, and the triangular or V-notch, with report of investigations of the last. Ills. 2500 w. Can Engr—Jan. 26, 1911. No. 20668.

Gauging and Recording the Flow of Streams. Samuel C. Chapman. Read before the Assn. of Water Engrs. Notes upon the yield and gaugings of streams. Discussion. 7500 w. Surveyor—Jan. 6, 1911. No. 20249 A.

MUNICIPAL.

City Planning.

The Building of the City. Henry Leffmann. Discusses city building and what it should accomplish, outlining the building of a model city. Discussion. 3500 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20576 D.

Comfort Stations.

The Most Up-to-date Public-Comfort Station in America. J. F. Brady. Illustrated description of a station of the underground type in Washington, D. C. 2000 w. Dom Engng—Dec. 31, 1910. No. 19848.

Drainage.

The Design of Storm Water Drains in a Modern Sewer System. Jean Bart Balcomb. Gives results of a study of the question at Kansas City, devoted exclusively to storm water drains. Discussion. 12500 w. Jour W Soc of Engrs—Dec., 1910. No. 20553 D.

The North Shore Drainage Channel at Chicago. Illustrates and describes this important addition to the Chicago main drainage canal, and to the sewage and water supply protection system. 1200 w. Eng News—Jan. 5, 1911. No. 19937.

See also Reclamation, under CONSTRUCTION.

Pavements.

Cement Grout Cushions in Street Railway Pavement Construction. From a report by Harry G. Davis on behalf of the Chicago Street Imp. Assn. 1500 w. Engng-Con—Jan. 25, 1911. No. 20610.

Repaving the "Loop" District in Chicago with Creosoted Wood Block. William W. Marr. Points out causes of failure in this kind of pavement, showing how better results may be obtained. Ills. 5000 w. Eng News—Dec. 29, 1910. No. 19797.

Winnipeg's Pavements. Brief description of the cedar block, macadam, and asphalt pavements, and their construction and cost. Ills. 3000 w. Can Engr—Jan. 19, 1911. No. 20378.

The Pavements of German Cities. A report on the pavements used in 80 cities having more than 5000 inhabitants. 3000 w. Eng Rec—Jan. 21, 1911. No. 20339.

Private Street Works as Administered Under the Heywood Corporation Act, 1883. Tom Fogg. Deals with the Street Works Clauses of the Borough of Heywood's Local Act. Ills. Also discussion. 4000 w. Surveyor—Dec. 23, 1910. No. 19968 A.

Refuse Disposal.

Disposition of Garbage in Various Cities. Information, from Consular Reports, concerning installations at Hamburg, London, Liverpool, Edinburgh, and Glasgow. 4000 w. Sci Am Sup—Jan. 14, 1911. No. 20174.

Plant for Handling and Storing Destructor Cinker. Illustrated description of the Westmount (Can.) clinker handling plant. 1000 w. Eng Rec—Jan. 21, 1911. No. 20340.

Roads.

The Road Problem. R. O. Wynne-Roberts. Read before the Inst. of Cleaning Supts. Discusses drainage, foundations, camber, wear, materials, and tar. 3500 w. Surveyor—Dec. 30, 1910. No. 20084 A.

The Opportunity for Technically Trained Men in Highway Work. A. N. Johnson. Read before the Am. Assn. for the Adv. of Sci. Information concerning early road building, recent improvements, and expenditures for roads, urging the training of engineers for this work. 2500 w. Eng Rec—Jan. 21, 1911. No. 20342.

The King's Highway. T. W. Wilkinson. Begins a review of the history of roads in England. The Roman roads are illustrated and described in the present number. 2200 w. Autocar—Jan. 7, 1911. Serial. 1st part. No. 20244 A.

English and American Highway Traffic Regulations. Arthur H. Blanchard and

We supply copies of these articles. See page 1022.

Henry B. Drowne. Read before the Am. Assn. for the Adv. of Sci. Statements of regulations adopted in the two countries, with recommendations of regulations having a direct bearing on the design of highways. 4000 w. Eng Rec—Jan. 14, 1911. No. 20181.

Report by a Board of Engineers on the Management of the Highway Department of the State of Washington. Full report. 5500 w. Engng-Con—Jan. 25, 1911. No. 20612.

Discussion on Road Construction and Maintenance; American Society of Civil Engineers. Report of discussion on the use of oils and bitumens on macadam. 3500 w. Eng News—Jan. 26. 1911. No. 20623.

Automobile Road Building. Logan Waller Page. Brief discussion of methods, conditions, and wear. 2500 w. Automobile—Jan. 12, 1911. No. 20194 C.

Road Construction Methods in Semi-Arid Regions. Charles R. Thomas. An account of methods used to meet special conditions. 1000 w. Engng-Con—Jan. 25, 1911. No. 20611.

Notes on Roadways for Residence Streets and Thoroughfares In and About New York City. Considers the several boroughs and the suburban towns in regard to the practice of building and maintaining roads. Also editorial. 24000 w. Eng News—Jan. 19, 1911. No. 20286.

Concrete Roads in Wayne County, Michigan. Brief description of the methods of construction. 1500 w. Eng Rec—Jan. 7, 1911. No. 20002.

A New Method of Consolidating Macadam Road Surfaces (Le Problème de la Route: Essai d'un nouveau Mode de Confection des Chaussées empierrées pour Répondre aux Besoins de la Circulation automobile). C. Guillet. Describes a new machine which consolidates the road surface by a ramming action. Ills. 3200 w. Génie Civil—Dec. 31, 1910. No. 20436 D.

The Present Status of Laboratory Tests and the Use of Materials in Road Construction. Major W. W. Crosby. Read before the Am. Assn. for the Adv. of Sci. Discusses various materials, the value of available information, and the need of research work. 2000 w. Engng-Con—Jan. 18, 1911. No. 20283.

Bitumens and Their Essential Constituents for Road Construction and Maintenance. Prévost Hubbard. Describes and discusses the various bituminous materials now used in road construction. 5600 w. U S Dept of Agri, Circ. 93—Jan. 27, 1911. No. 20675 N.

Tarred Roads and Vegetation. Marcel Mirande. Read before the French Acad. of Sci. Notes on the action of tar and its constituents on vegetation. 800 w. Surveyor—Jan. 6, 1911. No. 20250 A.

Experiences of the Massachusetts Highway Commission in Road Surface Preservation Work. Harold Parker. From a paper read before the Am. Road Makers' Assn. Gives experience with Aitkin spraying machine, for spraying refined tar under pressure, and the use of asphaltic oil. 1000 w. Engng-Con—Jan. 4, 1911. No. 20058.

Dust Prevention in Berlin (Die Bekämpfung des Strassenstaubs in Berlin). Herr Szalla. Reviews the use of various methods and materials for dust prevention. 5400 w. Zeitschr d Mit Motorwagen Ver—Dec. 15, 1910. No. 20470 D.

Sanitation.

Dust, Soot and Smoke. John B. C. Kershaw. Explains scientific methods of estimating dust and soot in the atmosphere and the density of chimney smoke. 3500 w. Cassiers Mag—Jan., 1911. No. 20308 B.

Discussion of Paper "The Contamination of City Air." Brief discussion of Dr. George A. Soper's paper. 3800 w. Jour Assn of Engng Socs—Dec., 1910. No. 20549 C.

Sanitation of Villages and Premises Without Sewers. John W. Hill. From *Bul. Ohio State Board of Health.* Discusses the disposal of village wastes, including domestic sewage and garbage. 3000 w. Can Engr—Jan. 26, 1911. No. 20667.

Sewage Disposal.

Principles of Sewage Disposal. George C. Whipple. Read before the Inst. of Chem. Engrs. Discusses in detail the basic principles underlying all methods of sewage disposal. 6500 w. Eng Rec—Jan. 7, 1911. No. 20008.

Sewerage and Sewage Disposal. Considers materials used for sewers and joints, methods of purification, their possibilities and limitations, etc. Ills. 2000 w. Munic Jour & Engr—Jan. 4, 1911. No. 20013.

Sewage Sludge Disposal. W. B. Ruggles. Deals with the various methods of disposing of the solid portion of sewage. 2000 w. Eng Rec—Jan. 21, 1911. No. 20344.

Sprinkling Filter Plant for Suburban Community. Paul Hansen. Illustrated description of the College Hill plant, near Cincinnati, O. Gives details and cost of construction. 4000 w. Munic Jour & Engr—Jan. 4, 1911. No. 20012.

Sewage Disposal Plants of Atlanta, Ga. W. T. Waters. Describes the proposed system which embodies the Imhoff tank. 3300 w. Munic Engng—Jan., 1911. No. 20330 C.

The Peachtree Creek Sewage Disposal Works at Atlanta, Ga. Illustrates and describes the general arrangement of the works. Three separate purification plants were made necessary by the topography of

We supply copies of these articles. See page 1032.

the country. 4500 w. Eng Rec—Dec. 31, 1910. No. 19870.

The Pennypeck Creek Sewage Disposal Works, Philadelphia, Pa. Illustrated detailed description of an experimental plant on a large scale to furnish information for the final purification of all the city sewage. It is the first Imhoff tank installation in this country. 3300 w. Eng Rec—Jan. 14, 1911. No. 20180.

See also Water Works, under WATER SUPPLY.

Sewers.

The Richmond Hill Trunk Sewer, Long Island. Illustrated detailed description of this new sewer which will collect both storm water and house sewage and discharge into Jamaica Bay. 2500 w. Eng Rec—Jan. 28, 1911. No. 20647.

Sewers and Sewer Construction in St. Louis. H. R. Fardwell. Detailed description of this combined system, its construction, and related subjects. Discussion. 5500 w. Jour Am Soc of Engng Contractors—Oct., 1910. No. 20526 N.

Sewer Construction at La Porte, Indiana. Ezra C. Shoecraft. Describes details of a combined system under construction. Ills. 1200 w. Eng Rec—Jan. 28, 1911. No. 20648.

Sidewalks.

Some Notes on Sidewalk Construction. Jerome B. Landfield. From a paper before the Nat. Assn. of Cement Users. Suggestions for concrete sidewalk work. 1500 w. Cement Age—Jan., 1911. No. 20631.

Trade Wastes.

The Disposal of Trade Wastes. George A. Johnson. Read before the N. J. San. Assn. Discusses the problems arising from their discharge into streams or sewers. 2500 w. Eng Rec—Dec. 31, 1910. No. 19869.

WATER SUPPLY.

Aqueducts.

The Disposal of Surplus Water and Electric Power from the Los Angeles Aqueduct. Burt A. Heinly. Presents suggestions for the proper distribution and sale of the surplus water and electric power. Ills. 5000 w. Eng News—Dec. 29, 1910. No. 19791.

Athens, Greece.

The Water Supply of Athens. An illustrated article describing the new works in connection with the supply from Lake Stymphalia, and the precautions necessary in a country subject to earthquakes. 3300 w. Engng—Jan. 6, 1911. No. 20261 A.

Co-operative Supplies.

The Advantages of Co-operation in Rural Water Supplies. F. Graham Fairbank. Gives the history of the rural district of Easingwold, showing that after trying to deal with the several villages in units, and failing, they had excellent results from co-operation. Map. 5000 w. Surveyor—Jan. 13, 1911. No. 20506 A.

Dams.

The Flow of Water Over Dams. Gardner S. Williams. An illustrated article giving useful data derived from model dams. 1500 w. Eng News—Jan. 12, 1911. No. 20138.

Dams, Barrages and Weirs on Porous Foundations. W. G. Bligh. Explains the principles underlying the successful design of hydraulic works founded on a loose porous foundation of sand, gravel or boulders, and deduces rules for their application. Ills. 3500 w. Eng News—Dec. 29, 1910. No. 19792.

Increasing an Ohio River Rise by Drawing Water from the Kanawha. Thomas E. Jeffries. Describes a method of manoeuvering the movable dams on the Kanawha as splash dams. Ills. 1500 w. Eng Rec—Jan. 28, 1911. No. 20653.

Puddle Walls for Eastern Dams With a Short Discussion of Other Cores. W. D'Rohan. Gives opinions of various engineers, both in England and America. 4500 w Engng-Con—Jan. 18, 1911. No. 20284.

Design and Construction of the Dam at St. Andrew's Rapids, Manitoba. A. H. Harkness. Illustrated description of a movable dam, of the type known as the Camere, the construction of which gave Winnipeg water communication with the lake. 3500 w. Can Engr—Jan. 26, 1911. No. 20666.

Methods of Constructing a Storage Reservoir Dam at Aziscohos Falls of the Androscoggin River. Seth A. Moulton. From a paper before the Nat. Assn. of Cement Users. Illustrates and describes work in connection with this water storage system in Maine. 6000 w. Engng-Con—Jan. 4, 1911. No. 20060.

The Construction of the Roosevelt Dam. Chester Wason Smith. An illustrated account of the difficulties encountered in constructing a high masonry dam in Arizona. 5500 w. Eng Rec—Dec. 31, 1910. No. 19867.

New Water Supply for Auckland, New Zealand. Illustrated description of the great concrete dam constructed in connection with the work of furnishing an additional water supply; with mention of other features of the work. 2800 w. Engr, Lond—Dec. 30, 1910. No. 20095 A.

Filtration.

Double Filtration of Water. H. W. Clark. Gives results of experimental investigations. 2500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20565 F.

The New Mechanical Filtration Plant at Bangor. Illustrated description of a new plant of improved design for purification of the Penobscot River water, which is a difficult problem. 2500 w. Eng Rec—Jan. 21, 1911. No. 20337.

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Irrigation.

Elementary Principles of Irrigation—Lateral Construction. F. W. Hanna. Discusses lateral cross-sections, drops, tap boxes, weir crests, checks, lateral banks, water losses, etc. 3500 w. Eng News—Jan. 26, 1911. No. 20616.

Meters.

Are Water Meters Advantageous or Otherwise? Edward W. Bemis. Discusses their advantages and the objections. 3500 w. Eng Rec—Jan. 28, 1911. No. 20650.

See also same title, under MECHANICAL ENGINEERING, MEASUREMENT.

Ohio River.

See Pollution, under WATER SUPPLY.

Pipe Corrosion.

The Corrosive Action of Water on Metals. Robert Spurr Weston. Discusses causes, effects and remedies. General discussion. 6000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20563 F.

Pipe Sizes.

Deduction of a General Formula for Determining the Most Economic Size of Pipe to Carry Pumped Water. Also editorial. Shows a simple rule closely applicable under wide variations of pipe, fuel and pump costs. 4000 w. Engng-Con—Jan. 25, 1911. No. 20613.

Piping.

Steel Pipes for Water Works. E. Kuichling. Gives much information in regard to materials used for water pipes, difference in corrosion, protective castings and related subjects. Discussion. 18500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20562 F.

Pollution.

Our Typhoid Streams. H. de B. Parsons. A discussion of the pollution of streams and the handling of sewage. 2500 w. Stevens' Ind—Jan., 1911. No. 20314 D.

A Health Department Report on the Upper Ohio River. Considers the Ohio River water in Pennsylvania, unsafe for human consumption unless purified. 2000 w. Eng Rec—Jan. 7, 1911. No. 20005.

Sanitary Survey of the Ohio River in Pennsylvania. Samuel G. Dixon, and F. Herbert Snow. Slightly condensed from conclusion of a report to the Joint Ohio River Sanitary Commission. 3500 w. Eng News—Jan. 5, 1911. No. 19940.

Purification.

Purification of Water Supply. Discusses methods available and where each is most effective. Ills. 3500 w. Munic Jour & Engr—Jan. 4, 1911. No. 20014.

The Purification Plant of the Rochester and Lake Ontario Water Company, Rochester, N. Y. James M. Caird. Detailed description with general discussion. 4000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20561 F.

Water Purification Plant, Washington, D. C. Results of Operation. E. D. Hardy. Gives a general description of the plant and a review of the results of five years operation. Ills. 10000 w. Pro Am Soc of Civ Engrs—Dec., 1910. No. 20550 F.

Methods and Costs of Construction of the Slow Sand Purification Works for the New Springfield, Mass., Water Supply. Charles R. Gow. Illustrates and describes in detail the methods and costs of constructing the works comprising this plant, explaining conditions and results. Discussion. 32600 w. Jour Assn of Engng Socs—Dec., 1910. No. 20548 C.

Water Purification and Sanitation at Panama. Information from a paper by John R. Downes, read before the Canal Zone Medical Soc., showing how troublesome the problems have been. 2500 w. Eng Rec—Jan. 14, 1911. No. 20185.

Purification of the Water Supply of Indian Collieries. H. C. H. Shenton. Considers methods of sterilization and their application to suit the conditions in each case. 2500 w. Col Guard—Dec. 23, 1910. No. 19970 A.

Rates.

The Method of Making Water Rates Ordered in Wisconsin. An account of the investigation and rate schedule ordered by the State Railroad Commission for Madison, Wis. 3000 w. Eng Rec—Jan. 7, 1911. No. 20011.

Reservoirs.

Cobb's Hill Reservoir, Rochester, N. Y. John F. Skinner. Illustrated detailed description. 2000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20560 F.

The New Central Reservoir of the People's Water Company, Oakland, Cal. C. H. Park, and G. S. Jacobs. Illustrated description of a recently completed concrete lined distributing and equalizing reservoir of 150,000,000 gals. capacity. 1200 w. Eng News—Jan. 5, 1911. No. 19938.

See also Silting, under WATERWAYS AND HARBORS.

Rochester, N. Y.

Memoranda Relative to the City of Rochester. Edwin A. Fisher. Information concerning the sewerage, pavements, water works, city government, etc. 3000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20558 F.

See also Water Works, under WATER SUPPLY.

Softening.

See Water Works, under WATER SUPPLY.

Tanks.

Elevated Tank of 200,000 Gallons Capacity, St. Louis, Mo. Illustrated description of a structure recently erected at the Insane Asylum. 1000 w. Eng News—Jan. 19, 1911. No. 20285.

Waste Detection.

Recent Waste Detection and Meter Work in the New York City Water De-

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partment. Edward W. Bemis. Describes waste detection and meter work during 1910. Also editorial. 6500 w. Eng News —Jan. 12, 1911. No. 20139.

Water Works.

Water-Works Statistics for the Year 1909, in Form Adopted by the New England Water-Works Association. Computed by Richard K. Hale. 5 tables. Jour N Eng W-Wks Assn—Dec., 1910. No. 20556 F.

Some Water-Works Statistics and Typical Data Showing Rate of Acquisition of Income for Domestic Service by Different Classes of Residential Property. Frank C. Jordan. Also discussion. 9500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20566 F.

I. A Rambling Description of the Rochester Water Works. Beekman C. Little. II. Pertinent Matters Relating to the Rochester Water Works. Frederick T. Elwood. 5000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20559 F.

The Water-Works and Sewerage of Monterrey, N. L., Mexico. George Robert Graham Conway. Maps and illustrated detailed description of these works, and of conditions and the geology of the country. 21500 w. Pro Am Soc of Civ Engrs—Dec., 1910. No. 20551 F.

Winnipeg's Water-Works. Describes an artesian supply for a population of 175,000. Ills. 4500 w. Can Engr—Jan. 19, 1911. No. 20380.

The Wellingborough Water-Works and Softening Plant. E. Young Harrison. Brief description of the working of the softening plant. Also discussion. 5500 w. Surveyor—Dec. 23, 1910. No. 19966 A.

Water-Works Depreciation.

Depreciation,—In Water-Works Operation and Accounting. Leonard Metcalf. Discusses methods of computing depreciation fund, approximate life renewals, etc. General discussion. 10500 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20557 F.

Water-Works Management.

Some Comments Upon Water-Works Management Suggested by the Recent Special Reports of the United States Commerce and Labor Department. Leonard Metcalf. Read before the Penn. W-Wks. Assn. 2500 w. Can Engr—Dec. 29, 1910. No. 19851.

WATERWAYS AND HARBORS.

Barge Canal.

The Situation Presented by the Constitutional and Statutory Provisions Governing the New York State Barge Canal Work and Character of Work Up to Date. Condensed reports of F. C. Stevens, Supt. of Public Works and of the Board of Advisory Consulting Engineers, with editorial. 9500 w. Engng-Con—Jan. 11, 1911. No. 20122.

Canals.

The Cape Cod Canal. R. P. Getty. An illustrated account of this new waterway —a sea-level canal 12 miles long—explaining its importance and describing the present progress of the work. 3500 w. Cassier's Mag—Jan., 1911. No. 20302 B.

The Brussels Ship Canal (Le Canal Maritime de Bruxelles). Brief description of the Willebroeck Canal and the harbor works at Brussels, and the project for making the canal available for large ships. Ills. 4800 w. Tech Mod—Dec., 1910. No. 20415 D.

Economic Importance of the Canalization of the Mosel (Die volks- und weltwirtschaftliche Bedeutung der Moselkanalisierung). Hermann Schumacher. Discusses its importance for the commerce of Germany and of the world. 10000 w. Tech u Wirt—Dec., 1910. No. 20711 D.

See also Silting, under WATERWAYS AND HARBORS.

Colorado River.

The U. S. Government Work on the Colorado River Break. Map and account of a break in 1909 and 1910, and the plans for restoring the river to its former bed and preventing future breaks. 500 w. Eng News—Jan. 26, 1911. No. 20617.

Dredges.

See same title, under MARINE AND NAVAL ENGINEERING.

Dredging.

A Plant for Removing Boulders from Dredging Spoil. Illustrated description of a plant used in connection with the Barge Canal work. 1500 w. Eng Rec—Jan. 28, 1911. No. 20652.

Dry Docks.

New French Dreadnought Dry Docks. Illustrations and information in regard to the new docks at St. Nazaire and Bordeaux. 1000 w. Engr, Lond—Jan. 6, 1911. No. 20269 A.

A 22000-Ton Floating Dry Dock for Brazil. Illustrated detailed description of a dry dock built in England and towed to Brazil. 7000 w. Int Marine Engng—Jan., 1911. No. 19924 C.

Floods.

The Menace of Danube Floods in Vienna (Wien von den Hochfluten der Donau dauernd bedroht). Anton Waldvogel. A long exposition of the danger, with a discussion on a previous paper on methods of protection. Ills. 1200 w. Zeitschr d Oest Ing u Arch Ver—Dec. 23, 1910. No. 20482 D.

Ice.

Ice Formation. H. T. Barnes. Brief account of the main results of a study of ice conditions on the St. Lawrence River. 3000 w. Jour N Eng W-Wks Assn—Dec., 1910. No. 20564 F.

Lighthouses.

A New Automatic Flashing Light. Illustrated description of an apparatus for

producing a flashing light and requiring attention at protracted intervals. 1600 w. Engr, Lond—Dec. 23, 1910. No. 19980 A.

Locks.

Methods of Constructing the Black Rock Harbor Lock; New York State Barge Canal. Illustrated detailed description of the cofferdam and lock construction at Buffalo, N. Y. 2000 w. Engng-Con—Jan. 4, 1911. No. 20057.

See also Excavation, under CONSTRUCTION.

Manzanillo.

The Port of Manzanillo. Harry H. Dunn. An illustrated description of harbor improvements on the Pacific coast of Mexico. 3000 w. Cassier's Mag—Jan., 1911. No. 20307 B.

Panama Canal.

The Panama Canal. Discussion held at the sessions of the Canal Zone meeting, November, 1910. 38500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20583 F.

A Report by a Geologist on Slides in Culebra Cut and by a Board of Engineers on the Revetment of the Sides of the Cut. The major part of these two reports with editorial. 3000 w. Eng News—Jan. 5, 1911. No. 19939.

See also Excavation. under CONSTRUCTION.

Shore Protection.

Methods of Shore Protection on the Sea Coast and on Canals (Uferbefestigungen an der Meeresküste and an Kanälen). Jonkheer Robert de Muralt. A review of practice in Holland. Ills. 3800 w. Zeitschr d Oest Ing u Arch Ver—Dec. 9, 1910. No. 20480 D.

Silting.

The Silting Up of Reservoirs and Canals and Some Methods for Preventing Same. W. D'Rohan. Considers appliances to cleanse reservoirs from silt after it is deposited, and devices to prevent silt from entering reservoirs. Ills. 4000 w. Engng-Con—Jan. 11. 1911. No. 20121.

Sluice Gates.

An Automatic Sluice Gate to Ensure Constant Water Level. E. Lauchli. Brief description with illustrations. 500 w. Eng News—Dec. 29. 1910. No. 19793.

Submarine Excavation.

The Operation of Rock Breakers at Black Rock Harbor. Illustrates and describes the use of the Lobnitz rock breakers in harbor improvement work at Buffalo, N. Y. 3500 w. Eng Rec—Jan. 7, 1911. No. 20001.

United States Waterways.

Waterways: Their Limitations and Possibilities. Frederic A. Delano. Extracts from a paper read before the Nat. Rivers & Harbors Cong. A critical discussion of cost and economy in relation to inland water transportation, especially the waterway from the Lakes to the Gulf. 2000 w. Eng News—Dec. 29. 1910. No. 19845.

The Relation of the Corps of Engineer Officers, U. S A., to River and Harbor Improvements. Gen. W. H. Bixby. From an address before the Nat. Rivers & Harbors Cong. Remarks on the education of engineer officers, and on river and harbor work. Considers depth of channel of secondary importance. 4500 w. Eng News—Dec. 29, 1910. No. 19796.

The Illinois Waterway. Robert Isham Randolph. Favorable to the construction of this waterway to connect the Great Lakes and the Mississippi River. 4500 w. Jour Am Soc of Engng Contractors—Oct., 1910. No. 20527 N.

Water Powers.

Utilization of the Water Powers of the Austrian Alps (Die Ausnutzung der Wasserkräfte in den österreichischen Alpenländern). H. Düll. This part discusses projects in northern Tyrol. Ills. Serial. 1st part. 3200 w. Elektrotech u Maschinenbau—Dec. 18, 1910. No. 20700 D.

Wave Action.

A Theory of the Water Wave. Morton F. Sanborn. Gives conclusions based on a study of the vertical circulation of water. 7000 w. Pro Am Soc of Civ Engrs—Dec. 1910. No. 20552 F.

MISCELLANY.

Aesthetics.

Art and the Engineer. James P. Haney. Lecture before the Stevens Engng Soc. On the value of beauty in engineering work. The true meaning of art and its applications. 2500 w. Stevens' Ind—Jan., 1911. No. 20316 D.

Explosions.

The Disastrous Explosion at Jersey City, N. J., on Feb. 1, 1911. An illustrated account of the dynamite explosion and its effects. 600 w. Eng News—Feb. 9, 1911. No. 20917.

Military Engineering.

Military Engineering. C. W. Otwell. Considers the engineering work for which engineers of the army must be fitted. Ills. 14000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20577 D.

Philippines.

Philippine Public Works. Information from the annual report concerning work carried out during the year ending June 30, 1910. Ills. 1500 w. Far East Rev—Dec., 1910. No. 20887 N.

Rock Crushing.

A Rock Crushing and Storage Plant at Tomkins Cove, N. Y. Illustrated description of a plant having a crushing and screening capacity of 1000 yds. per hour of commercial sizes of product. 4500 w. Eng Rec—Jan. 7, 1911. No. 20003.

The New Stone Crushing Plant of the Tomkins Cove Stone Co., Tomkins Cove. N. Y. Illustrated description of plant and equipment for the economical production of crushed stone. Also editorial. 5500 w. Eng News—Jan. 12, 1911. No. 20137.

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ELECTRICAL ENGINEERING

COMMUNICATION.

Condensers.

Mica Condensers as Standards of Capacity. Harvey L. Curtis. Research work made to determine to what extent a mica condenser can be considered a satisfactory standard of capacity. 12600 w. Bul Bureau of Stand—Nov., 1910. No. 20540 N.

Radiotelegraphy.

Notes on the Oscillation Transformer. John Stone Stone. Mathematical determination of the constants of oscillation transformers used in wireless telegraphy. 1000 w. Elec Wld—Jan. 19, 1911. No. 20296.

The Comparative Sensitiveness of Some Common Detectors of Electrical Oscillations. Louis W. Austin. Describes some experimental comparisons of the sensitiveness of wireless detectors. Ills. 3000 w. Bul Bureau of Stand—Nov., 1910. No. 20543 N.

The Theory and Practice of Wireless Detectors as at Present Used. S. M. Powell. The present article considers methods of testing detectors, connection of detectors, and types. 2000 w. Elec Rev, Lond—Jan. 6, 1911. Serial. 1st part. No. 20246 A.

Wireless Communication from Air Ships. A. Frederick Collins. Illustrates and describes the apparatus used in the dirigible balloon "America.' 2000 w. Cassier's Mag—Jan., 1911. No. 20304 B.

Transmission of Time Signals by Wireless (Transmission de l'Heure par le Télégraphie sans Fil). M. Béache. Describes practice in Europe, particularly at the Eiffel Tower in Paris. Ills. 1600 w. Génie Civil—Dec. 10, 1910. No. 20427 D.

Radiotelephony.

Dubilier's New Commercial Wireless Telephone. C. O. White. Illustrated description. 1800 w. Elect'n, Lond—Dec. 30, 1910. No. 20082 A.

Telephone Cables.

The Cuntz Electric Cable. Brief description of an invention of J. H. Cuntz in which the retarding and distorting effects are overcome by means of distributed conductance. Ills. 500 w. Stevens' Ind—Jan., 1911. No. 20317 D.

Telephone Law.

Public Telephone Service (La Servitu delle Condutture telefoniche). F. Agnello. A digest and discussion of Italian telephone law. Serial. 1st part. 3000 w. Ann d Soc d Ing e d Arch Ital—Nov. 1. 1910. No. 20438 F.

Telephone Systems.

Telephone Service in Chicago. Alfred U. Hoefer. Brief account of the service of a very large system. Ills. 1000 w. Wis Engr—Jan., 1911. No. 20327 C.

Telephony.

A System of Multiplex Telephony. Illustrated description of the multiplex signaling system invented by Major George Owen Squier. Ills. 1500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20200.

Long-Distance Telephony. J. J. Carty. From the *Nat. Tel. Jour.* A statement with respect to the condition of long distance telephony in the United States. 3000 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20661.

DISTRIBUTION.

Wiring.

Wiring of a New York Loft Building. John P. Morrissey. Illustrated description of the wiring of a 19-story building in which the electrical equipment is of the highest grade. 2500 w. Elec Wld—Jan. 26, 1911. No. 20636.

DYNAMOS AND MOTORS.

A. C. Generators.

A Generator with Variable Number of Poles (Ein polumschaltbarer Generator). F. Niethammer and E. Siegel. Reports tests of such a generator designed for varying the frequency of a transmission system with induction motor loads. Ills. 2500 w. Elektrotech u Maschinenbau—Dec. 4, 1910. No. 20496 D.

Commutation.

Commutation Phenomena in D. C. Machines. G. W. Worrall. Rewritten from paper before the Inst. of Elec. Engrs. Discusses the requirements of the well-designed brush holder, and the carbon brush, and considers the electrical and magnetic phenomena in commutation. Ills. 2500 w. Mech Engr—Jan. 6, 1911. No. 20251 A.

What Is a Commutator? George S. Hodgins. Explains this device for converting an alternating current into a continuous one. Ills. 1000 w. Ry & Loc Engng—Jan., 1911. No. 20019 C.

Design.

Examples in Dynamo Design. Explains the physical basis of the relationships which enter into the calculations, and gives examples of the connections proved by practice to be necessary to produce efficient results, explaining how the determinations may be made. 1200 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20254 A.

Flame-Proof Heaters.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Induction Motors.

Probable Developments of Asyuchronous Motors. J. Fischer-Hinnen. Abstract of an article in *Elektrotechnische Zeit.*

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Explains a method, described in one of the Oerlikon Co.'s patents, for reducing the starting current. Ills. 1600 w. Elect'n, Lond—Dec. 30, 1910. No. 20079 A.

The Circle Diagram of the Polyphase Induction Motor (Das Kreisdiagramm des mehrphasigen Asynchrommotors). Karl Krug. Mathematical. Ills. 4200 w. Electrotech u Maschinenbau—Dec. 4, 1910. No. 20495 D.

Starters.

A Simple Method of Determining the Number of Steps for Shunt-Wound Motor and Rotor Starters (Ein einfaches Hilfsmittel zur Bestimmung der Stufen von Anlassern für Nebenschlussmotoren und Rotoranlassern). Hans Zallud. Ills. 1800 w. Elektrotech u Maschinenbau—Dec. 25, 1910. No. 20701 D.

ELECTRO-CHEMISTRY.

Calcium Cyanamid.

What Is "Cyanamid?" John Woods Beckman. An explanation of three different substances that go under this name. 1000 w. Met & Chem Engng—Jan., 1911. No. 20124 C.

Electric Furnaces.

Electric Furnaces. Carl Hering. Reviews the rapid development and discusses the commercial importance. 3000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20051.

Thermal Resistance and Conductance; the Thermal Ohm and Thermal Mho. Carl Hering. Urges that a name be given to the unit of thermal resistance, suggesting the "thermal ohm" for thermal resistances, and "thermal mho" for thermal conductances, and giving a table of conversion factors. 2500 w. Met & Chem Engng—Jan., 1911. No. 20125 C.

The Reliability of Electric Furnaces. F. T. Snyder. Read before the Chicago Soc. of the Am. Elec-Chem. Soc. Discusses factors in the development under American conditions. 2500 w. Ir Age—Jan. 26, 1911. No. 20599.

Electric Induction Furnaces (Forni elettrici ad Induzione). Remo Catani. A comprehensive review of the various types and their applications. Ills. Serial. 1st part. 2400 w. Industria—Dec. 4, 1910. No. 20441 D.

A New Form of Electrode. A. Mahlke. Suggests an arrangement for securing the same current density throughout an electric furnace. Ills. 500 w. Met & Chem Engng—Jan., 1911. No. 20132 C.

A New Electric Furnaces for Steel Melting and Refining. Joh. Härdén. Illustrated description of a combined arc and resistance furnace known as the "paragon." 1000 w. Met & Chem Engng—Jan., 1911. No. 20130 C.

Electrochemistry.

What Electrochemistry Is Accomplishing. Joseph W. Richards. Address before the Am. Elecchem. Soc. Discusses modern methods and results in industrial processes. 3500 w. Sci Am Sup—Jan. 28, 1911. Serial. 1st part. No. 20638.

Electrometallurgy.

Present Status of Electrometallurgy (Lo Stato attuale dell' Elettrometallurgia). Gino Gallo. A review of furnaces and processes, discussing principally iron metallurgy but including reference to all the non-ferrous metals. Ills. 10800 w. Ann d Soc d Ing e d Arch Ital—Nov. 15, 1910. No. 20439 F.

Electroplating.

A Review of the Nickel Plating Industry. Charles H. Buchanan. Historical review of practice from the early 70's. 1700 w. Brass Wld—Jan., 1911. No. 20300.

A Simple Method of Recovering Silver from Silver Plating Solutions. Describes a method requiring no special apparatus, and entirely free from danger as the cyanide is not decomposed. 1500 w. Brass Wld—Jan., 1911. No. 20299.

ELECTRO-PHYSICS.

Circuits.

Unusual Current Relations in Condensive and Inductive Circuits. Alfred Still. Explanation of some results obtained under actual working conditions. 1000 w. Elec Wld—Jan. 26, 1911. No. 20634.

Conductors.

The Stretching of a Conductor by Its Current. Carl Hering. Gives certain reasons which tend to show that a force lengthwise to a conductor ought to be produced by the current flowing through it; and describes experiments which show that such a force exists. Ills. 4000 w. Jour Fr Inst—Jan., 1911. No. 20322 D.

Hysteresis.

Magnetic Hysteresis at the Temperature of Liquid Air. R. Beattie and H. Gerrard. Experiments are described showing the effect of temperature on both "rotational" and "alternational" hysteresis in iron, steel, nickel, and cobalt. Liquid air was used for producing the low temperatures required. 2500 w. Elect'n, Lond—Dec. 23, 1910. No. 19961 A.

Hysteresis and Eddy Current Exponents for Silicon Steel. W. J. Wooldridge. Shows apparent changes in general direction of curves required for predetermining core losses of apparatus in which silicon steel is used. 600 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20589 F.

Inductance.

The Mutual Inductance of Two Parallel Coaxial Circles in Terms of Hypergeometrical Series. Frederick W. Grover. Mathematical. 2000 w. Bul Bureau of Stand—Nov., 1910. No. 20541 N.

Induction.

A Research for a Simple Theory of Self Induction (Versuch einer Elementar-

We supply copies of these articles. See page 1032.

theorie der Selbstinduktion). Hans Neubauer. Derives a theory of self induction from elementary principles. Ills. Serial. 1st part. 2400 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 3, 1910. No. 20150 D.

Magnetic Properties.

The Magnetic Properties of Iron Alloys and Their Uses in Alternate-Current Design. Dr. S. Guggenheim. Abstract of lecture before the Phys. Gesell. Describes experiments on a series of alloys of silicon and iron. 1500 w. Elect'n, Lond—Jan. 13, 1911. No. 20501 A.

Magnetism.

Mechanical Forces in Magnetic Fields. Charles P. Steinmetz. Gives a general study of these forces. Also a more accurate design of the electromagnet which permits the determination of its efficiency. 2500 w. Pro Am Inst of Elec Engrs—Dec., 1910. No. 19710 F.

A Study of Unbalanced Magnetic Pull. Charles R. Moore. Gives a method, more or less graphical, for studying magnetic pull, which does not require higher mathematics. Ills. 2500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20198.

Magnetomotive Force in Non-Uniform Magnetic Paths. A. Miller Gray. Solves the problem of calculating the ampere-turns necessary to send a given flux through the teeth of a d. c. machine. Also editorial. 1200 w. Elec Wld—Jan. 12, 1911. No. 20136.

Mechanical Analogies.

Mechanical and Electrical Analogies (Mechanisch-elektrische Analogien). K. Wessely. Discusses mechanical analogies with certain phenomena of transformer and generator working. Mathematical. Ills. 3500 w. Elektrotech u Maschinenbau—Dec. 18, 1910. No. 20499 D.

Oscillations.

Resonance without Damping (Resonanz ohne Dämpfung). Fritz Emde. Mathematical discussion of the effect on undamped oscillations of resonance with and external periodic force. Ills. 2200 w. Elektrotech u Maschinenbau—Dec. 25, 1910. No. 20702 D.

Radioactivity.

Radioactivity. Madame P. Curie. Introduction to a forthcoming book, giving a résumé of our present knowledge. 2500 w. Sci Am Sup—Dec. 31, 1910. No. 19789.

GENERATING STATIONS.

Accumulators.

Thomas A. Edison's Latest Invention. Joseph B. Baker. Illustrated description of the new battery. 3000 w. Sci Am—Jan. 14, 1911. No. 20166.

Envelope or Thin Plates for Storage Batteries. Stockton H. Mortimer. Discusses the characteristic features of these two types. 1200 w. Elec Wld—Jan. 19, 1911. No. 20297.

The Capacity and Efficiency of Storage Batteries. W. M. MacLeod. Discusses the eccentricities of storage batteries, giving data for design and discussing capacity, efficiency, etc. 2500 w. Sib Jour of Engng—Dec., 1910. No. 20335 C.

See also Substations, under TRANSMISSION.

Central Stations.

Quarry Street Station Completed. Illustrated detailed description of the latest generating plant of the Commonwealth Edison Company, in Chicago, with continuous rating of 84000 kw. 5500 w. Elec Wld—Jan. 5, 1911. No. 20115.

The Vendin-le-Vieil Generating Plant (Usine génératrice de Vendin-le-Vieil). Describes a plant designed to utilize coke-oven gas from the Lens collieries. Ills. 2600 w. L'Elecn—Dec. 31, 1910. No. 20421 D.

Hydro-Electric.

Hydro-Electric Practice. H. A. von Schon. Considers the principles of design of hydro-electric plants. 2500 w. Munic Engng—Jan., 1911. No. 20331 C.

The Ontario Hydroelectric System. Illustrated detailed description of the generation, transmission and distribution of electrical energy in Ontario. 4500 w. Elec Rev and W Elect'n—Dec. 31, 1910. No. 19859.

Electricity from a Drainage Canal. First part of an illustrated report on the hydroelectric development of the Chicago Drainage Canal. Also editorial. 4000 w. Elec Wld—Jan. 12, 1911. Serial. 1st part. No. 20135.

The Menominee & Marinette Hydro-Electric Development. Illustrated detailed description of a development on the Menominee River to supply these cities of Wis. and Mich. with electricity for light, power and street railway service. 2000 w. Eng Rec—Jan. 14, 1911. No. 20176.

Hydroelectric Power at Wausau, Wis. D. B. Hanson. Brief illustrated description of three small plants drawing their power from the Wisconsin River. 1600 w. Power—Jan. 24, 1911. No. 20389.

The Hydro-Electric Nitrogen Works at Notodden, Norway. Abstract from *Teknisk Ugeblad*. Illustrated detailed description. 2500 w. Elec Rev, Lond—Dec. 30, 1910. No. 20078 A.

The Hydroelectric Plant at Madiéres. C. L. Durand. Illustrated description of a generating plant on the Vis River in France. 1400 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20197.

The Ventavon Hydro-Electric Plant on the Durance (Usine Hydro-Electrique de Ventavon sur la Durance, Hautes-Alpes). Ch. Dantin. Describes the main features of this 28,000 horse-power development. Ills. 4000 w. Génie Civil—Dec. 31, 1910. No. 20435 D.

We supply copies of these articles. See page 1022.

The Lagastrello Hydro-Electric Plant (L'Impianto idro-elettrica del Lagastrello della Societa idro-elettrica Ligure). Brief description of a plant supplying power to Isola, Italy. 2200 w. Monit-Tech—Dec. 10, 1910. No. 20440 D.

See also Lines, under TRANSMISSION; Water Powers, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Isolated Plants.

Power Plant of the Raike Building. Osborn Monnett. Illustrates and describes a plant of 160 kw. Capacity furnishing electric power to manufacturing works in the building. 1200 w. Power—Jan. 10, 1911. No. 20101.

Electricity in a Huge Mail Order Establishment. Illustrated description of the installation at the Chicago plant of Sears, Roebuck & Company. 2500 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20659.

Switchgear.

Switchgear and the Isolation of Faults on Power Supply Systems. H. W. Clothier. Read before the Newcastle Loc. Sec. of the Inst. of Elec. Engrs. Considers the essentials of a large power supply undertaking, and the systems of protection. Ills. Discussion. 10800 w. Elec Engr, Lond—Dec. 30, 1910. No. 20077 A.

LIGHTING.

Coal Mines.

See Mine Lighting, under MINING AND METALLURGY, COAL AND COKE.

Illumination.

The New Era in Electrical Illumination. Rollin W. Hutchinson, Jr. Third and last article of a series, dealing with glower and vapor lamps and their characteristics. Ills. 2500 w. Engineering Magazine—Feb., 1911. No. 20679 B.

Reflection Co-efficients. Paul F. Bauder. Abstract of a paper before the N. Y. Sec. of Ill. Engng. Soc. Discusses the importance of reflection and absorption in interior illumination. 3000 w. Elec Rev & W Elect'n—Jan. 28, 1911. No. 20660.

The Illumination of Interiors. J. T. Morris. Aims to correct some mistaken ideas which prevail. The present number discusses daylight illumination. 1500 w. Archt, Lond—Jan. 6, 1911. Serial. 1st part. No. 20241 A.

Incandescent Lamps.

Incandescent Lamps in 1910. Charles F. Scott. A review of progress in the manufacture and applications. 1000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20050.

Recent Progress in Electric Lighting. E. W. Marchant. Abstract of paper read before the Ill. Engng. Soc. Considers recent developments in incandescent lamps and gives particulars of experiments on the effect of repeated switching on and off of metal lamps, the effect of vibration, life of lamps, etc. Distribution is discussed and arc lamp progress and vapor lamps. Discussion. 5500 w. Elect'n, Lond—Dec. 23, 1910. No. 19960 A.

The Effect of Wave Form Upon Incandescent Lamps. Morton G. Lloyd. Read before the Am. Phys. Soc. & Am. Assn. for the Adv. of Sci. An investigation to determine the effect upon candle power and upon life of lamps. Mathematical. 2500 w. Elec Rev & W Elect'n—Jan. 14, 1911. No. 20199.

Photometry.

Photometric Units and Nomenclature. Edward B. Rosa. A systematic discussion of the mathematical and physical relationships of the various protometric quantities. 6000 w. Bul Bureau of Stand—Nov., 1910. No. 20544 N.

Progress.

The Lighting Situation. Louis Bell. A review of progress during the past year. 1800 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20049.

Street.

Intense Street Lighting. Alton D. Adams. Discusses illumination with tungsten incandescent and flaming arc lamps, comparing with carbon arcs, and criticizing methods. 2000 w. Munic Jour & Engr—Jan. 11, 1911. No. 20143.

Public Lighting in the City of London. Illustrated review of the history of street lighting by electricity in London. 2500 w. Elec Rev, Lond—Dec. 23, 1910. Serial. 1st part. No. 19957 A.

The Use of Reflectors in Street Lighting (Emploi de Réflecteurs économiseurs pour l'Eclairage des Voies publiques). A. Grebel. Discusses the curves of distribution of various light sources, and available economizing reflectors. Ills. 3200 w. Génie Civil—Dec. 17, 1910. No. 20429 D.

Vacuum Tubes.

Temperature and Potential-Pressure Relations in the Mercury Arc. C. T. Knipp. Abstract of an article in the *Phys. Rev.* Investigates the temperature of the mercury arc by means of a thermo-junction for pressures up to 3 mm. of mercury at a constant current of 3 amperes. 1500 w. Elect'n, Lond—Dec. 30, 1910. No. 20080 A.

MEASUREMENT.

Electrodynamometers.

A New Method for the Absolute Measurement of Electric Quantity. Burton McCollum. Describes a type of electrodynamometer which appears to be free from the objections to the ordinary types, and it is believed no serious difficulties are introduced. 6000 w. Bul Bureau of Stand—Nov., 1910. No. 20542 N.

Laboratories.

The Electrical Testing Laboratory at the Berlin Technical High School (Das

Elektrotechnische Versuchsfeld der Technischen Hochschule zu Berlin). W. Reichel and M. Gerstmeyer. Describes the laboratory arrangement and equipment. Ills. Serial. 1st part. 3200 w. Zeitschr d Ver Deutscher Ing—Dec. 17, 1910. No. 20707 D.

Meters.

Electricity Recording Meters. W. H. Alabaster and N. A. Wheaton. Considers the construction and general performance of types employed at the Melbourne City Council's plant. 1200 w. Aust Min Stand —Nov. 30, 1910. Serial. 1st part. No. 20071 B.

Oscillographs.

The Testing of Oscillographs (Theoretisches zur Prüfung von Oszillographen). Fritz Emde. A technical discussion of the testing of oscillographs with reference to their inertia and damping effect, Ills. 2800 w. Elektrotech u Maschinenbau—Dec. 11, 1910. No. 20497 D.

Phasemeters.

A New Model of the Hartmann and Braun Phasemeter (Phasemètre Hartmann et Braun, Nouveau Modèle). M. Aliamet. Describes improvements introduced in this device by Dr. Bruger. Ills. 1500 w. L'Elecn—Dec. 31, 1910. No. 20420 D.

TRANSMISSION.

Balancers.

The Theory of the Static Balancer. C. C. Hawkins. Considers the simple two-phase case when the third wire is disconnected from the balancer, and when connected. 2000 w. Elect'n, Lond—Jan. 13, 1911. No. 20503 A.

Cables.

See Electric Power, under MINING AND METALLURGY, COAL AND COKE.

Fault Isolation.

See Switchgear, under GENERATING STATIONS.

Insulators.

Open Atmosphere and Dry Transformer Oil as High-Voltage Insulators. Harris J. Ryan. Report of high-voltage line tests, discussing the high-tension transmission corona problem. Ills. 23000 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20584 F.

Line Construction.

Construction of a Transmission Line in Arizona. Illustrated description of the towers and poles and general construction work. 2000 w. Eng Rec—Jan. 28, 1911. No. 20651.

Line Design.

Design, Construction and Test of an Artificial Transmission Line. J. H. Cunningham. A line constructed to investigate and study phenomena in connection with switching, sudden load, etc., is described. Ills. 1800 w. Pro Am Inst of Elec Engrs—Jan. 1911. No. 20586 F.

Line Losses.

Tests of Losses on High Tension Lines. G. Faccioli. Gives results of tests on the lines of the Central Colorado Power Co. Ills. 3800 w. Pro Am Inst of Elec Engrs —Jan., 1911. No. 20587 F.

High Voltage Line Loss Tests Made on the 100-Kilovolt 60-Cycle 180-Mile Transmission Line of the Central Colorado Power Company. E. L. West. Charts. 800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20585 F.

Line Plans.

Network Plans and Diagrams. Charles W. Rycroft. Plans and information from the writer's experience relating to a successful system. 1000 w. Elec Rev, Lond —Jan. 13, 1911. No. 20399.

Lines.

North-East Coast Power Supply. Illustrated description of the transmission and distribution lines to collieries. Map. 6000 w. Elect'n, Lond—Jan. 13, 1911. No. 20500 A.

The 70,000-Volt Installation at Molinar on the Jucar, Spain (Electrische Krachtsoverbrengingen. 70,000 Volt Installatie te Molinar a/d. Jucar in Spanje). J. W. Van Dijk. Describes particularly the high-tension transmission line. Ills. 9800 w. De Ingenieur—Dec. 31, 1910. No. 20713 D.

Line Testing.

See Line Losses, under TRANSMISSION.

Poles.

A Portable Collapsible Mast. Illustrated description of an ingenious German invention. 1000 w. Sci Am—Dec. 31, 1910. No. 19788.

Damage to Chestnut Telephone and Telegraph Poles by Wood-Boring Insects. Thomas E. Snyder. Reports serious damage and investigations resulting in practical methods of preventing injury. Ills. 4000 w. U S Dept of Agri—Bul. 94. Serial. Part I. No. 20676 N.

Protective Devices.

Merz-Price Protective Gear and Other Discriminative Apparatus for A. C. Circuits. K. Faye-Hansen, and G. Harlow. Abstract of a paper before the Manchester Sec. of the Inst. of Elec. Engrs. Descriptive. Short discussion. 1500 w. Elect'n, Lond—Jan. 6, 1911. No. 20247 A.

Regulations.

The French Law of March 21, 1910, and the Regulations of the Union des Syndicats (A Propos de l'Arêté du 21 Mars 1910 et des Instructions de l'Union des Syndicats). Discussion of M. Boucherot's paper. 8800 w. Bul Soc Int d Elecns—Dec., 1910. No. 20402 F.

Rotary Converters.

Discussion on "Interpoles in Synchronous Converters," New York, Nov. 11, 1910. The paper by B. G. Lamme and F. D. Newbury. 9800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20591 F.

We supply copies of these articles. See page 1022.

Substations.

Storage-Battery Substation for Detroit River Tunnel Electric Railway Installation. Illustrated account of a substation to meet special requirements. 2000 w. Elec Wld—Jan. 26, 1911. No. 20633.

Transformers.

Commercial Problems of Transformer Design. H. R. Wilson. Brief discussion of how best to balance engineering and commercial conditions. 1800 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20590 F.

Current-Ratio and Phase-Angle Test of Series Transformers. H. S. Baker. Describes a method for determining the current ratio by opposing the m. m. f. of the primary current to that of the secondary current when the two currents are passed around a special test core. Diagram. 700 w. Elec Wld—Jan. 26, 1911. No. 20635.

The Temperature Gradient in Oil Immersed Transformers. James Murray Weed. An investigation which undertakes, by a study of the laws of cooling, to formulate a correct theory applicable to the general case. 6500 w. Pro Am Inst of Elec Engrs—Jan., 1911. No. 20588 F.

Two-Phase.

Operation of a Two-Phase Distribution System. Alden W. Welch. Explains present practice. 1500 w. Elec Wld—Jan. 5, 1911. No. 20116.

Voltage Regulation.

Single-Phase Feeder Regulators. Edwin E. Lehr. Illustrates and describes regulators of the indication type giving information concerning their use. 4000 w. Elec Rev & W Elect'n—Dec. 31, 1910. No. 19860.

MISCELLANY.

Insulating Materials.

Asphalts and Bitumens in Electrical Work. C. Toone. A sketch of the nature of these materials and their use for insulating. 2000 w. Cassier's Mag—Jan., 1911. No. 20303 B.

Paris Flood.

Electrical Machinery in the Paris Flood of January, 1910 (L'Inondation de Janvier 1910 et le Matériel électrique). M. Guery. Describes the effect of the flooding on electrical apparatus, the damage caused, and the repairs necessary. 8400 w. Bul Soc Int d Elecns—Dec., 1910. No. 20405 F.

Patents.

Review of Electrical Patents of the Year 1910. Edward E. Clement. A review of the past year's work in the line of electrical inventions. 4000 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20053.

Review of 1910.

Progress in 1910. Collection of articles by known writers, dealing with notable features and tendencies in their respective lines. 20000 w. Elec Jour—Jan., 1911. No. 20323.

INDUSTRIAL ECONOMY

Accounting.

Orders, Records, Expense Accounts. Holden A. Evans. Outlines a cost system, describing methods. 4000 w. Am Mach—Vol. 33. No. 52. No. 20223.

Expense Accounts and Analysis. Holden A. Evans. Gives an outline of expense schedules and a form of comparative monthly analysis. 4000 w. Am Mach—Jan. 12, 1911. No. 20233.

Apprenticeship.

Educating Apprentices on the Santa Fe. F. W. Thomas. Abstract of paper read at the convention of the Nat. Soc. for the Pro. of Ind. Ed. Describes the school work and shop instruction. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20031.

Cost Systems.

Distribution of Indirect Costs. Holden A. Evans. A discussion of methods. 5000 w. Am Mach—Vol. 33. No. 51. No. 20221.

Cost System for Shops of Medium Size. Strickland L. Kneass. Explains a system in use by a manufacturer of brass injectors. 1000 w. Am Mach—Jan. 19, 1911. No. 20370.

Sound Business Methods in the Foundry. Ellsworth M. Taylor. A summary of foundry cost elements with illustrations of their application. 2800 w. Ir Age—Jan. 5, 1911. No. 19922 D.

Education.

New Engineering Laboratory, University of Sydney. Plans, photographs and brief description. 1800 w. Engr, Lond—Jan. 13, 1911. No. 20519 A.

The Training of Chemical Engineers. M. C. Whitaker. Read before the Am. Inst. of Chem. Engrs. Discusses the training needed for the requirements of the chemical industries. 3000 w. Met & Chem Engng—Jan., 1911. No. 20123 C.

The Conference Department at Lehigh University. Dr. Henry S. Drinker. An account of method for assisting deficient scholars in the first two years of the college course. 1500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20582 F.

The Continuation Schools of Munich. Dr. Georg Kerschensteiner. Discusses the aims of such schools and the difficulties and methods of overcoming them. 4000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20569 F.

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The Formation of the Commercial Engineer (La Formation de l'Ingénieur commercial). Emile Waxweiler. Read at the International Congress on Technical Education. Discusses the planning of courses for education for business careers. 6200 W. Rev de Métal—Dec., 1910. No. 20408 E + F.

Engineers' Licenses.

The Licensing of Engineers; Action of the American Society of Civil Engineers. Also account of the annual meeting, and editorial. A draft of the law prepared by a committee of Am. Soc. of Civ. Engrs. with editorial discussion. 7500 w. Eng News—Jan. 26, 1911. No. 20624.

Industrial Safety.

Industrial Safety (Technik und Versicherung). Alfred Manes. A review of the study of conditions of industrial safety in Germany. 4000 w. Tech u Wirt—Dec., 1910. No. 20712 D.

Labor Agreements.

Collective Bargaining in England (Le Contrat collectif de Travail en Angleterre). Maurice Bellom. A review of a recent Board of Trade report, with reference to its interest for French manufacturers. Ills. Serial. 1st part. 1800 w. Génie Civil—Dec. 24, 1910. No. 20434 D.

Management.

The Twelve Principles of Efficiency. Harrington Emerson. This ninth article of a series considers the seventh principle: dispatching. 3500 w. Engineering Magazine—Feb., 1911. No. 20684 B.

Systematic Foundry Operation and Foundry Costs. C. E. Knoeppel. This fifth article of a series discusses the importance of efficient dispatching in the foundry. 4500 w. Engineering Magazine—Feb., 1911. No. 20682 B.

Standards of Efficiency in Shop Operations. Harrington Emerson. Extracts from an address on "Justice, Common Sense, and the Pay Roll," delivered at the N. Y. meeting of the Nat. Civic Fed., Jan. 12, 1911. Discusses the element of justice in scientific management. 3500 w. Ir Age—Jan. 19, 1911. No. 20278.

See also same title, under RAILWAY ENGINEERING, MISCELLANY.

Monopoly.

Monopoly and Progress. Dr. Franz Junge-Hermsdorf. Second of three articles on industrial conditions in the United States. The present number discusses the menace of international money power. 4500 w. Engineering Magazine—Feb., 1911. No. 20678 B.

Patents.

Patents—What They Are, and How to Read and Understand Them. S. E. Darby. An elementary explanation of the nature of patents. 2500 w. Elec Ry Jour—Jan. 21, 1911. No. 20294.

Southern States.

Some Fundamental Elements in Southern Industrial Development. Dr. David T. Day. Reviews the industries that have contributed to the rapid development of the South. 3000 w. Mfrs' Rec—Jan. 5, 1911. No. 19992.

Stores Keeping.

See Supply Department, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Wage Systems.

The Premium Plan of Paying for Labor. Clinton Alvord. An explanation of the premium plan and its working, comparing with other systems. 4000 w. Jour Worcester Poly Inst—Jan., 1911. No. 20319 C.

MARINE AND NAVAL ENGINEERING

Battleships.

Progress of Warships and Machinery Under Construction in England. Review of progress in naval construction in England during the last six months of 1910. 2500 w. Engr, Lond—Jan. 13, 1911. No. 20518 A.

The Armament of Recent Battleships (Les Installations d'Artillerie à Bord des Cuirassés récents). P. Bourgoin. Discusses the arrangement of guns and mechanisms for their operation. Ills. 10500 w. Rev Gen d Sci—Dec. 30, 1910. No. 20417 D.

Colliers.

Fleet Collier Cyclops. Illustrates and describes the leading characteristics of this vessel, of the twin screw, single deck type. 1500 w. Marine Rev—Jan., 1911. No. 20239.

Dredges.

Clay-Cutting Hydraulic Dredger for the River Nile. Illustrated description. 700 w. Engng—Jan. 6, 1911. No. 20263 A.

Two New Dredgers. Illustrations and brief descriptions of a twin-screw suction and buckel-dredger for the Hai-Ho River, and a bow-well bucket dredger for Adelaide harbor. 500 w. Engr, Lond—Dec. 30, 1910. No. 20097 A.

German and American Electrically Operated Bucket Dredges (Elektrisch angetriebene Löffelbagger deutscher und amerikanischer Bauart). Hubert Hermanns. Describes a number of types. Ills. 4000 w. Elek Kraft u Bahnen—Dec. 24, 1910. No. 20494 D.

Electric Power.

Ship Propulsion by Electricity (Indirekte elektrische Schiffsantriebe). F.

We supply copies of these articles. See page 1022.

Niethammer and E. Siegel. An illustrated review of the various direct- and alternating-current systems proposed. Ills. 3700 w. Elek Kraft u Bahnen—Dec. 4, 1910. No. 20492 D.

Ferryboats.

Screw Ferryboat Dutchess. Illustrated description of this steel ferry steamer. 700 w. Int Marine Engng—Jan., 1911 No. 19925 C.

Paddle Ferry Steamer San Pedro. Profile, plans, and description of a new ferryboat for the A., T. & S. F. R. R. Co., building at San Francisco. It is of the double ended paddle type with feathering wheels. 1000 w. Marine Rev—Jan., 1911. No. 20237.

Gas Engines.

Producer Gas for Marine Service. E. W. Graef. Describes small plants, ranging from 25 to 200-h.p. which are easily handled by one man. 2200 w. Rudder—Jan., 1911. No. 20109 C.

German Association.

The Twelfth Session of the German Naval Association (Die Zwölfte Hauptversammlung der Schiffbautechnischen Gesellschaft). O. Flamm. Abstracts of the papers and discussions. Ills. Serial. 1st part. 4800 w. Schiffbau—Dec. 14, 1910. No. 20458 D.

Hydroplanes.

How to Build a Glider, Kestrel. Walter M. Billing. An illustrated study of the construction of gliders, and of materials used. 3000 w. Rudder—Jan., 1911. No. 20108 C.

Naval Engineering.

Naval Engineering Progress. H. I. Cone. Abstract of a lecture at the Newport Naval War College. Reviews improvements introduced and the results. 7000 w. Int Marine Engng—Jan., 1911. No. 19926 C.

Naval Organization.

Engineering in the Navy. Its Organization and Efficiency. Ira N. Hollis. An endorsement of Sec. Meyers reorganization of the Navy. 7000 w. Engineering Magazine—Feb., 1911. No. 20677 B.

Oil Engines.

An Ocean-Going Oil Engine Ship. Illustrated description of the "Vulcanus," a full-powered ocean-going internal-combustion-engine boat. Fitted with a reversible Diesel motor. 4000 w. Engr, Lond—Jan. 6, 1911. Serial. 1st part. No. 20270 A.

Propulsion.

Modern Methods of Marine Propulsion (Moderni Mezzi di Propulsione Marina). E. Ferretti. A review of recent proposals, involving the use of gas, oil, or electric power, speed-reducing gears, etc. Ills. 16000 w. Riv Marit—Dec., 1910. No. 20437 E + F.

The Application of the Jet Propeller in Turbine Steamers (Ueber die Verwendbarkeit des Pumpenpropellers bei Turbinendampfern). Moritz Kroll. Examines the possibility of employing centrifugal pumps driven by turbines for ship propulsion. Ills. 3000 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 10, 1910. No. 20467 D.

Review of 1910.

See Shipbuilding, under MARINE AND NAVAL ENGINEERING.

Salving.

The Army Engineers' Plan for Raising the Wreck of the "Maine": The Design of Cofferdams for Very Deep Water. Editorial on the object of the work and the means of carrying it out, especially considering the cofferdams. Ills. 3000 w. Eng News—Dec. 29, 1910. No. 19799.

Salving the Northwestern. An account of this Alaska liner, stranded in Puget Sound, describing methods used to successfully bring the vessel into Seattle harbor for repairs. 1200 w. Marine Rev—Jan., 1911. No. 20238.

The Rescue of a Sunken German Submarine. Illustrated account of how the "U. 3" was raised by a special floating dock built for that purpose. 800 w. Sci Am—Jan. 28, 1911. No. 20642.

Shipbuilding.

Shipbuilding and Marine Engineering in 1910. A review of this industry in the United Kingdom. 9000 w. Engng—Jan. 6, 1911. No. 20268 A.

Naval Shipbuilding in 1910. Editorial review of the progress during the past year in the navy shipbuilding of Great Britain. 3000 w. Engng—Dec. 30, 1910. No. 20093 A.

Chantier et Ateliers de St. Nazaire. Illustrates and describes work at the Penhoët shipbuilding yard, on the Bay of Biscay, and the equipment of the yard. Plate. 5000 w. Engng—Dec. 23, 1910. No. 19972 A.

Shipbuilding Rules.

Germanischer Lloyd Rules, 1910. Arthur R. Liddell. Reviews the changes made and new ideas embodied in the 1910 edition of the rules of this society. 2000 w. Engr, Lond—Dec. 30, 1910. No. 20099 A.

Ship Resistance.

Water Resistance of Birds and Bird Forms. Tatsugoro Inouye. Written from the "graduation essay." Investigations showing advantage of bird-form over ship-form. Ills. 800 w. Engng—Jan. 13, 1911. No. 20517 A.

Ship Stability.

Graphical Representation of the Stability and Trim of Ships (Graphische Darstellung der Anfangsstabilität und Trimlagen von Schiffen). E. Veronese. Outlines a method of investigation. Ills. 1200 w. Schiffbau—Dec. 14, 1910. No. 20459 D.

Ship Testing.

The Determination of the Height of the Centre of Gravity by Means of Listing Tests (Bemerkungen über die Bestim-

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mung des Gewichtsschwerpunktes der Höhe nach mit Hilfe des Krängungsversuches). Alfred Schmidt. Describes the method. Ills. 1800 w. Schiffbau—Dec. 28, 1910. No. 20460 D.

Steam Boilers.

The Design of a Marine Boiler. An illustrated study of the design of a four-furnace boiler. 4500 w. Boiler Maker—Jan., 1911. No. 20111.

An Improved Type of Marine Boiler. C. M. Olsen. The improvement consists in dispensing with the water-filled space around the combustion chamber, and arranging a water tube system and superheater in the space gained. Ills. 1000 w. Boiler Maker—Jan., 1911. No. 20112.

Steamships.

A Tank Steamer for the Molasses Trade. Illustrated detailed description of the steamer "Currier," to run between Cuba, Porto Rico, and New York. 3500 w. Int Marine Engng—Jan., 1911. No. 19927 C.

United States Navy.

See Naval Organization, under MARINE AND NAVAL ENGINEERING.

Yachts.

British-Built Power Yachts. J. Rendell Wilson. Illustrates and describes interesting points in connection with the machinery of recent power yachts built in English yards. 2000 w. Rudder—Jan., 1911. No. 20107 C.

MECHANICAL ENGINEERING

AERONAUTICS.

Aeroplane Design.

Disposition of Motors and Seats in Aeroplanes (Disposition des Motors und der Sitze bei Flugapparaten). Hans Zeyssig. Reviews the principles and gives examples of practice. Ills. Serial. 1st part. 1200 w. Motorwagen—Dec. 30, 1910. No. 20473 D.

Aeroplanes.

Two Interesting New French Aeroplanes. Illustrated descriptions of the De Pishof monoplane, and the Paulhan biplane. 1500 w. Sci Am—Jan. 28, 1911. No. 20641.

Aeroplane Speed.

A Study of the Variable-Speed Aeroplane (Etude d'un Aéroplane à Vitesse variable). Suggests lines of inquiry which may lead to increased safety in aeroplanes. Ills. 2700 w. Génie Civil—Dec. 24, 1910. No. 20433 D.

Aeroplane Stability.

Automatic Stabilizing System of the Wright Brothers. Illustrated description of an interesting control system for the Wright aeroplanes. 1800 w. Sci Am Sup—Jan. 14, 1911. No. 20173.

Airship Flights.

The Brucker Transatlantic Airship Expedition. Carl Dienstbach. Illustration and account of the airship, under construction, which will attempt to cross the Atlantic from the Cape Verde Islands, traveling with the trade winds. 2500 w. Sci Am—Jan. 21, 1911. No. 20387.

Exhibitions.

The Paris Aeronautical Exhibtion. W. F. Bradley. Illustrates and describes the exhibits as types of the most recent aeroplanes and motors. 2500 w. Cassier's Mag—Jan., 1911. No. 20301 B.

Motors.

Aeroplanes and Airship Engines. Illustrates and describes a number of designs. 2500 w. Mach, N Y—Jan., 1911. No. 19880 C.

French Aeroplane Engines. Warren H. Miller. Brief illustrated descriptions of famous French engines for aeroplanes. 2500 w. Rudder—Jan., 1911. No. 20110 C.

The N. E. C. Two-Stroke Petrol Engine. Illustrated description of a new engine used on a Wright biplane. 1500 w. Auto Jour—Dec. 24, 1910. No. 19955 A.

Review of 1910.

Progress in Aviation in 1910. Rene Gasnier. in *L'Aerophile*. A review. 2500 w. Sci Am Sup—Jan. 7, 1911. No. 19944.

Aeronautics. Reviews the notable flights of 1910, and comments on the elimination of chance, and the showman's influence. 3500 w. Engr, Lond—Jan. 6, 1911. No. 20272 A.

AUTOMOBILES.

Agricultural Machinery.

Agricultural Motor Trials. Gives details of the trials held by the Roy. Agri. Soc. of England at Boldock. 4000 w. Engng—Jan. 13, 1911. No. 20512 A.

Ball Bearings.

Loads on Rear-Axle Ball Bearings (Belastung von Kugellagern in Automobillinterradachsen). J. Dornacher. Tabulates the loads on bearings in various European cars. Ills. Serial. 1st part. 2000 w. Motorwagen—Dec. 20, 1910. No. 20472 D.

Brakes.

Something New in Brakes. Illustrates and describes the Giusti pneumatic brake system. 1500 w. Auto Jour—Dec. 31, 1910. No. 20075 A.

Carburetors.

Carburetors and Fuel Systems at the Show. Albert L. Clough. General review of features of interest. 2500 w. Horseless Age—Jan. 18, 1911. No. 20386.

Unique System of Carburation. Illustrates and describes the Welsh automatic

carburettor. 2000 w. Auto Jour—Dec. 31, 1910. No. 20074 A.

Commercial Vehicles.

The Commercial Motor Truck vs. the Horse. Harry W. Perry. An illustrated comparison of efficiency and cost. 3000 w. Sci Am—Jan. 14, 1911. No. 20170.

Accessibility of Parts in Commercial Vehicles. H. A. Morris. Discusses the importance of this feature of design. 4000 w. Com Veh—Jan., 1911. No. 20015 C.

Worm Drive Latest for Commercials. Illustrated review of features observed at the recent show in Madison Square Garden, N. Y. 3000 w. Automobile—Jan. 26, 1911. No. 20687 C.

Gasoline Motor Trucks and Delivery Wagons at the Palace Show. A. C. Woodbury. General review of the exhibits. 1800 w. Horseless Age—Jan. 11, 1911. No. 20206.

Mechanical Review of the Commercial Vehicle Show. A. C. Woodbury. Illustrates and describes interesting features of the exhibits. 4000 w. Horseless Age—Jan. 25, 1911. No. 20655.

See also Garages, under AUTOMOBILES.

Cost.

Why You Can Buy a Good Car for Little Money. Harold Whitney Slauson. Shows how the mass production of motor cars has made possible efficient automobiles at lower prices. 3000 w. Sci Am—Jan. 14, 1911. No. 20169.

Cunningham.

Cunningham Car. Illustrated description of a new car shown at the Palace Auto Show, N. Y. 1500 w. Horseless Age—Jan. 11, 1911. No. 20205.

Design.

The Structural Engineering of Motor-Cars. John L. Milligan. Read before the Manchester Assn. of Engrs. Deals only with pleasure cars. Ills. 2500 w. Mech Wld—Dec. 23, 1910. Serial. 1st part. No. 19965 A.

Electric.

The Modern Pleasure Electric Vehicle. William W. Hudson. Illustrated detailed description of interesting improvements in design and construction. 2200 w. Sci Am—Jan. 14, 1911. No. 20167.

See also Garages, under AUTOMOBILES.

Electric Meters.

Ampere-Hour Meter for Electrics. R. C. Lanphier. Read before the Soc. of Auto. Engrs. Types of ampere-hour meters are illustrated and described, explaining the principle and value. 4000 w. Automobile—Jan. 19, 1911. No. 20356.

Exhibitions.

Eleventh A. L. A. M. Show Greatest Ever Seen. Illustrated general description of arrangements at Madison Square Garden, N. Y. City. 3500 w. Horseless Age—Jan. 11, 1911. No. 20201.

Mechanical Features of Cars at the Palace Show. A. C. Woodbury. Reviews features of construction embodied in the cars shown, which are mostly of the low or medium priced class. 3500 w. Horseless Age—Jan. 4, 1911. No. 20062.

Some New Mechanical Features at the Palace Show. Chester S. Ricker. Illustrates and describes the Cole lubrication system, oil circulation by flywheel, valve covers instead of valve caps, etc. 2000 w. Horseless Age—Jan. 11, 1911. No. 20204.

Enclosed Front Bodies at the Palace Show. Chester S. Ricker. Illustrates and describes features of interest at this exhibition in New York City. 5000 w. Horseless Age—Jan. 4, 1911. No. 20061.

Control Systems at the Madison Square Show. D. R. Hobart. Remarks on the diversity of design of the various levers and pedals. Ills. 2500 w. Horseless Age—Jan. 11, 1911. No. 20203.

Body Details at Garden Show. Chester S. Ricker. Exhibits are illustrated and described. 2500 w. Horseless Age—Jan. 11, 1911. No. 20202.

The Automobile at the Brussels Exposition (Das Automobil auf der Brüsseler Weltausstellung 1910). A. Haenig. A review of the exhibits. Ills. Serial. 1st part. 3600 w. Zeitschr d Mit Motorwagen Ver—Dec. 31, 1910. No. 20471 D.

Wheels and Tires at the Paris Salon, Dec. 3-18, 1910 (Les Roues et les Bandages au Salon de l'Automobile, Paris, 3-18 Décembre 1910). Jean Boutaric. Describes the novelties among the exhibits. Ills. 2000 w. Génie Civil—Dec. 17, 1910. No. 20430 D.

Fire Apparatus.

Apparatus for Efficient Fire Fighting. Arguments favoring the adoption of motor fire apparatus. 1700 w. Munic Engng—Jan., 1911. No. 20333 C.

Fires.

Fire Protection. N. B. Pope. Read before the Soc. of Auto Engrs. Brief discussion of the causes and methods of prevention. 1200 w. Automobile—Jan. 12, 1911. No. 20193 C.

Garages.

The Small, Inexpensive Garage. H. P. Wilkin. Illustrates and describes knock-down and unit type of portable structures. 3000 w. Sci Am—Jan. 14, 1911. No. 20172.

Proper Garaging of Electric Commercial Vehicles. C. L. Morgan. From a paper read before the Elec. Veh. Assn. of Am. The best equipment for garages and methods to be adopted for the care and maintenance of machines. 3000 w. Com Veh—Jan., 1911. No. 20016 C.

Gears.

Efficiency of Worm Drives. F. E. Watts. Gives data of tests showing that it is possible to secure efficiencies approximating 90 per cent. 1500 w. Horseless Age—Dec. 28, 1910. No. 19849.

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Ignition.

Magneto Ignition Practices. Discusses and illustrates magnetos employed in automobile ignition work, stating the limitations. 4500 w. Automobile—Jan. 12, 1911. No. 20195 C.

Lighting.

Electric Lighting Systems. A review of general principles with details of the most widely used types. Ills. 2500 w. Serial. 1st part. Autocar—Jan. 14, 1911. No. 20394 A.

Electric Lighting Systems Seen at the Show. Albert L. Clough. Describes several of the systems shown, calling attention to the differences. 1600 w. Horseless Age—Jan. 18, 1911. No. 20385.

Motor Compression.

Variation of Mean Effective Pressures in Automobile Engines. David Landau. An investigation of the effects of compression, compression chamber form, piston speed, valve sizes and valve timing. 2500 w. Horseless Age—Jan. 25, 1911. Serial. 1st part. No. 20657.

Motor Design.

Power Calculations for Motors. W. D. Ennis. Suggests a method for determining the (water-cooled) cylinder dimensions suitable for required service regardless of horse-power rating. 2500 w. Automobile—Jan. 5, 1911. No. 20054 C.

Motor Efficiency.

Carbon Monoxide Stifles Efficiency. Calls attention to the loss of power and lack of fuel economy due to thermic troubles. 3000 w. Automobile—Jan. 5, 1911. No. 20055 C.

Thermal Efficiency of a Two-Cycle Petrol Engine. W. Watson and R. W. Fenning. Read before the Incor. Inst. of Auto. Engrs. Describes a series of experiments carried out, stating results. Ills. 2500 w. Auto Jour—Dec. 24, 1910. Serial. 1st part. No. 19956 A.

Motor Fuels.

Commercial Gasoline. F. H. Floyd. Read before the Soc. of Auto. Engrs. Discusses the impurities that are being encountered. 4000 w. Automobile—Jan. 12, 1911. No. 20189 C.

Motor Lubrication.

Lubrication for Motors. Shows how the pressure varies and discusses the efficacy of the plans in vogue. 2000 w. Automobile—Jan. 5, 1911. No. 20056 C.

Motors.

Technical Review of Motors. Review of development, discussing types and features of design. 10000 w. Automobile—Jan. 26, 1911. No. 20685 C.

Two Cycle Engines at the Madison Square Garden Show. A. C. Woodbury. Describes changes and new designs shown. Ills. 2000 w. Horseless Age—Jan. 25, 1911. No. 20656.

The Two-Stroke Engine. Some facts relating to the faults of the old type and to recent improvements. 2200 w. Auto Jour—Dec. 24, 1910. No. 19954 A.

New Sleeve Type of Motor. Information concerning a patent issued to Robert Miller, relating to 4-cycle internal combustion motors of the sleeve type. Ills. 1800 w. Automobile—Dec. 29, 1910. No. 19854.

Motor Valves.

Novelties in Valves. E. P. Batzell. Read before the Soc. of Auto. Engrs. Outlines recent developments, including combinations of rotary, poppet, sleeve, piston and others. Ills. 3500 w. Automobile—Jan. 12, 1911. No. 20191 C.

Slide-Valve Motors (Schiebermotoren). K. Praetorius. A discussion of the valve problem in automobile motors. Ills. Serial. 1st part. 1000 w. Motorwagen—Dec. 30, 1910. No. 20474 D.

Omnibuses.

Motor-Omnibuses of the Paris General Omnibus Company. Illustrates and describes improvements introduced in the latest vehicles for this company. 1200 w. Engng—Jan. 13, 1911. No. 20514 A.

Repairs.

A Few Shop Jobs on an Old Car. Herbert L. Towle. Useful hints for the man handy with tools. 2000 w. Sci Am—Jan. 14, 1911. No. 20171.

Road Guides.

Some Remarkable Mechanical Road Guides. Harry W. Perry. Illustrates and describes ingenious devices for indicating the proper route for touring cars. 2000 w. Sci Am—Jan. 14, 1911. No. 20168.

Selden Patent.

The Defect of the Selden Patent. Editorial on the decision of the U. S. Court of Appeals, reversing the decision of the Circuit Court which in 1909 affirmed the validity of the Selden automobile patent. 2500 w. Eng News—Jan. 19, 1911. No. 20288.

Sleighs.

Motor Sleighs for Antarctic Expeditions. Drawings and details of the sleigh and motor, with description. 1000 w. Engng—Dec. 23, 1910. No. 19973 A.

Testing.

Mechanical Proving of Automobiles. John Squires. Describes tests made with an absorption dynamometer. Ills. 3000 w. Am Mach—Jan. 26, 1911. No. 20604.

Tires.

Semi-Pneumatic Tyre Construction. Illustrated description of the "E. D." tyre. 1800 w. Auto Jour—Jan. 14, 1911. No. 20395 A.

Care and Repair of Tires. Suggestions for the care of the spare tire so that it will not deteriorate. Ills. 1500 w. Automobile—Dec. 29, 1910. No. 19852.

Transmission.

Transmission. Discusses prevailing types of automobile transmission gears,

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flexibility, etc. Ills. 2200 w. Automobile—Jan. 26, 1911. No. 20686 C.

Relation of the Gear Ratio. William D. Ennis. Discussing the ability of the motor, the work it has to do, the governing condition, etc. 2000 w. Automobile—Jan. 26, 1911. No. 20688 C.

"Frictionless" Friction Drive. Charles E. Duryea. Read before the Soc. of Auto. Engrs. Treats of roller, shaft, and cham types of drives in motor operation, giving results of tests. 3000 w. Automobile—Jan. 12, 1911. No. 20190 C.

See also Commercial Vehicles and Gears, under AUTOMOBILES.

Wheels.

Demountable Rims. Illustrates and describes various schemes used to facilitate the replacement of tires. 2000 w. Automobile—Jan. 12, 1911. No. 20196 C.

Spoke Material Running Short. Discusses methods by which the supply of hickory can be maintained. 3000 w. Automobile—Jan. 19, 1911. No. 20354.

Avoid Broken Wheels. Gives characteristics and tests of hickory as it is used for spokes and felloes for automobile wheels, showing how to avoid defective wood. 1500 w. Automobile—Dec. 29, 1910. No. 19853.

COMBUSTION MOTORS.

Gas-Engine Design.

See Engine Design, under STEAM ENGINEERING.

Gas Engines.

Compression and Explosion Pressures and Temperatures in Gas and Oil Engines. W. Manktelow. Mathematical discussion of compression pressures and temperatures. 1200 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20256 A.

A New German Gas Engine. Illustrates and describes details of the double-acting, four-cycle engine built by Ehrhardt & Sehmer. 1800 w. Ir Age—Jan. 5, 1911. No. 19911 D.

Gasoline Engines.

See Motor Efficiency, under AUTOMOBILES.

Gas-Power Plants.

Gas and Oil Engine Central Stations (Stations centrales à Gaz pauvre et à Moteurs Diesel, à Huile lourde). P. Calfas. An abstract of the report of M. Thonet to the International Tramway Congress last September, giving data of first and operating costs in a number of large stations. Ills. 3500 w. Génie Civil—Dec. 24, 1910. No. 20432 D.

See also Refrigeration, under HEATING AND COOLING.

Gas Producers.

Recent Gas Producers (Quelques Gazogènes récents). A review of recent gas-producer literature and patents. Ills. 7500 w. Rev de Mécan—Dec., 1910. No. 20413 E + F.

Oil Engines.

See Gas Engines, under COMBUSTION MOTORS; and Oil Engines, under MARINE AND NAVAL ENGINEERING.

HEATING AND COOLING.

Hot-Air Heating.

A New England School Heating System. Plans and description of a system installed in Braintree, Mass. 2000 w. Met Work—Jan. 7, 1911. No. 19989.

Design of Fan Blast Heating. H. C. Russell. Gives data on the proportioning of heating apparatus for factories, schools and public buildings. 2000 w. Met Work—Jan. 21, 1911. Serial. 1st part. No. 20348.

Hot-Water Heating.

See Steam Heating, under HEATING AND COOLING.

Liquid Oxygen.

Separation of Oxygen by Cold. James Swinburne. A Faraday Soc. paper. Explains the principle and its application. 6000 w. Met & Chem Engng—Jan., 1911. No. 20128 C.

Modern Practice.

What Is the Matter with Modern Heating Practice? Konrad Meier. An answer to the agitation against present methods. 3500 w. Heat & Vent Mag—Jan., 1911. No. 20568.

Plumbing.

Plumbing in a New York Apartment House. Illustrates and describes numerous special features. 3000 w. Met Work—Jan. 7, 1911. No. 19987.

Refrigeration.

Clearance and Its Effect on the Volumetric Efficiency of Ammonia Compressers. V. R. H. Greene. Read before the Am. Soc. of Refrig. Engrs. Presents results of research work. 2500 w. Ice & Refrig—Jan., 1911. No. 19999 C.

Clearance in Single-Acting and Double-Acting Ammonia Compressors. Thomas Shipley. Read before the Am. Soc. of Refrig. Engrs. Gives data from test runs. Ills. 500 w. Ice & Refrig—Jan., 1911. No. 20000 C.

A description of the "Mederer" Chilling Chamber. H. W. Miller. Illustrated description of a chamber for producing artificial cold for the preservation of food stuffs. Discussion. 2500 w. Jour S African Assn of Engrs—Oct.-Nov., 1910. No. 20073 F.

A Gas Producer Operated Refrigerating Plant. Roderick H. Tait. Read before the Am. Soc. of Refrig. Engrs. Plan and description of a gas-driven plant. 2000 w. Ice & Refrig—Jan., 1911. No. 19998 C.

Steam Heating.

Pipe Line Sizes for Central Station Heating. Byron T. Gifford. Read before the Am. Soc. of Heat. & Vent. Engrs. Explains a simple manner of determining

the proporting for both steam and hot-water systems. 1500 w. Met Work—Jan. 28, 1911. No. 20632.

Rehabilitation by Vacuum Heating. Illustrated description of changes in the Boston City Hospital to secure better performance of heating plants. 3500 w. Met Work—Jan. 21, 1911. No. 20347.

Temperature Control.

Temperature Control in House Heating. Illustrates and describes types of apparatus for securing satisfactory and economical control of heating equipment. 2000 w. Met Work — Jan. 7, 1911. No. 19990.

Ventilation.

The Transmission of Air and Its Movement in Ducts. George W. Knight and Perry West. The development of a new scheme for proportioning air ducts and outlets. 3000 w. Heat & Vent Mag —Jan., 1911. No. 20567.

Mechanical Ventilation. J. Radcliffe. Based on a paper read before the Heat. & Vent. Engrs. Discusses the requirements of a perfect system of ventilation and means of attaining the desired results. 3000 w. Mech Engr—Jan. 6, 1911. No. 20252 A.

Notable Scheme of School Ventilation. Illustrates and describes the system installed in the East Side High School, Pittsburg. Has an air tunnel 15 ft. wide and 6 ft. high, and exhaust air tunnels underneath fresh air tunnels. 5000 w. Met Work—Jan. 7, 1911. No. 19986.

The Ventilation of Large Halls (Lüftung und Kühlung von Sälen). M. Hottinger. A practical discussion of the desiderata and methods of securing them. Ills. Serial. 1st part. 2500 w. Schweiz Bau—Dec. 10, 1910. No. 20464 D.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

The Influence of Form of Blades in Centrifugal Pumps. Maurice F. Fitzgerald. An analytical and graphical study. Ills. 2000 w. Engr, Lond—Dec. 30, 1910. No. 20094 A.

The "Tan-Gyro" Centrifugal Pump. Illustrated description of a high-efficiency rotary pump. 1000 w. Engng—Jan. 6, 1911. No. 20265 A.

Recent Centrifugal Pumps (Neuere Zentrifugalpumpen). G. Ziehn. Describes new theories, new types, and new applications. Ills. Serial. 1st part. 4000 w. Die Turbine—Dec. 20, 1910. No. 20466 D.

Standardization of Centrifugal Pumps by the Firm of A. Borsig (Die Normalisierung der Kreiselpumpen bei A. Borsig in Berlin-Tegel). Ernst Blau. Describes the sizes and types manufactured for stock by this firm. Ills. 2300 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20708 D.

Gas Pumps.

Humphrey Internal Combustion Pump. Edward N. Trump. The Humphrey gas pump is illustrated and described, and tests reported. 4000 w. Am Mach—Jan. 5, 1911. No. 20229.

Presses.

See Hydraulic Presses, under MACHINE ELEMENTS AND DESIGN.

Turbines.

Reaction Turbines to Operate Under 670 Feet Head. H. Birchard Taylor. Illustrates and describes the design of the turbines being erected in the Noriego plant of the Michoacan Power Co., in Mexico. 3500 w. Eng Rec—Jan. 21, 1911. No. 20338.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Recent Tests of Ball and Roller Bearings (Nouveaux Essais sur les Roulements à Billes et à Rouleaux). Ch. Gégauff. An extension of the author's previous tests investigating the comparative amounts of power absorbed by ball, roller, and ordinary bearings under various conditions. Ills. 4200 w. Génie Civil—Dec. 3, 1910. No. 20425 D.

Recent Ball and Roller Bearings and Their Trial in Practice (Neuere Kugel- und Rollenlager und deren Bewährung in der Praxis). August Bauschlicher. Describes various types recently developed in Germany. Ills. Serial. 1st part. 2500 w. Zeitschr f Werkzeug—Dec. 5, 1910. No. 20476 D.

See also Lubrication, under POWER AND TRANSMISSION.

Bushes.

The Fitting of Bushes. James Stormonth. Suggestions, with illustrations. 2000 w. Mech Wld—Dec. 30, 1910. No. 20087 A.

Standard Bushings for Drill Jigs. Lucian Haas. Illustrations and dimensions of standard types which experience has proved satisfactory. 1100 w. Am Mach—Vol. 33. No. 51. No. 20219.

Clutches.

The Design of Leather Cone Clutches. Considers the principles underlying the proportions of the frictional surfaces. 1800 w. Autocar—Dec. 31, 1910. No. 20076 A.

Friction Clutch for Machine Tools. Robert Reid. A pneumatically operated friction clutch, successfully applied to large planers and slotters, is illustrated and described. 1600 w. Am Mach—Jan. 12, 1911. No. 20234.

Elastic Bodies.

Propagation of Stresses in Elastic Bodies (Propagation des Pressions dans les Corps elastiques). R. A. Henry. A theoretical and experimental investigation. Ills. 7000 w. Rev de Métal—Dec., 1910. No. 20409 E + F.

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Hydraulic Presses.

Strain Rods for Hydraulic Presses. A. Lewis Jenkins. Gives formulae for determining the proportions of the tension members, with illustrations of different methods of fastening. 1000 w. Am Mach—Vol. 33. No. 52. No. 20224.

Rotating Drums.

The Design of Rotating Drums (Die Berechnung rotierender Trommeln). A criticism of R. Lorenz's paper on this subject by Kurt von Sanden, with a reply by Dr. Lorenz. Ills. 4200 w. Zeitschr d Ver Deutscher Ing—Dec. 3, 1910. No. 20704 D.

Screw Threads.

The Unification of Systems of Screw Threads (L'Unification des Systèmes de Filetage). F. Cellerier. Outlines the present state of the movement for international standardization. Ills. 6000 w. Tech Mod—Dec., 1910. No. 20414 D.

Springs.

Finding the Value of "E" for Springs. George F. Summers. Gives a simple test by which the quality of the material may be determined. Ills. 600 w. Am Mach—Jan. 26, 1911. No. 20602.

MACHINE WORKS AND FOUNDRIES.

Aluminum Founding.

Oxidation of Aluminum. Considers aluminum castings and methods of preventing porosity. 2000 w. Foundry—Jan., 1911. No. 19907.

Annealing.

See Malleable Iron, under MATERIALS OF CONSTRUCTION.

Assembling.

The Assembly of Small Interchangeable Parts. John Calder. Outlines a system for securing rapid and economical production. 2200 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20573 F.

Brass Founding.

American Practice in Casting Brass for Rolling; A Description of the Methods Now Used in the Casting Shops of the Leading Brass Rolling Mills. Erwin S. Sperry. Ills. 4000 w. Brass Wld—Jan., 1911. No. 20298.

Blemishes on Brass Castings. C. Vickers. Discusses methods necessary to produce fine brass work. Ills. 3000 w. Foundry—Jan., 1911. No. 19906.

Button Making.

Punches and Dies for Metal Buttons. A. F. Horton. Illustrated description of combination dies for blanking, drawing and embossing at one operation. 1500 w. Am Mach—Jan. 26, 1911. No. 20605.

Cam Cutting.

Cutting Plate Cams on Milling Machine. R. F. Biesemeier. Has particular reference to the making of plate cams for the automatic screw machine. Gives tables of gearing and angles of inclination for leads between 0.075 and 5 inches. Ills. 2500 w. Am Mach—Jan. 12, 1911. No. 20232.

Milling Screw Machine Cams. William W. Johnson. Illustrates and describes a method of finding the angle to which the spiral head is to be set, and the lead for which the spiral head is to be geared. Supplement. 1500 w. Mach, N. Y—Jan., 1911. No. 19879 C.

Castings.

Die-Casting. A. C. von Dreele. Illustrates and describes the process, machinery and dies used in an interesting manufacturing operation. 4000 w. Mach, N. Y—Jan., 1911. Serial. 1st part. No. 19877 C.

Chip Briquettes.

Briquettes from Cast Borings. Reviews two recent articles in *Stahl und Eisen*, by E. Leber, and A. Messerschmidt, on results from their use in making iron castings, with special reference to cupola reactions. 2500 w. Ir Age—Jan. 12, 1911. No. 20113.

Briquetting Cast-Iron Chips and Their Utilization in the Cupola (Die Brikettierung von Guss- und Eisenspänen und ihre Schmelzung im Kupolofen). A Messerschmidt. Reviews unsatisfactory results of using cast-iron chips in the cupola without briquetting, and discusses the behavior in the cupola of briquettes made by the Ronay process. Ills. 8750 w. Stahl u Eisen—Dec. 7. 1910. No. 20444 D.

Chips.

Melting Cast Iron Chips in the Cupola. W. F. Prince. Gives full details of the Prince process which has given successful results. Ills. 2500 w. Am Mach—Jan. 26, 1911. No. 20601.

Cupola Practice.

Utilization of Cast Iron Borings. John Jacobson. Gives excellent results obtained from the Prince process of charging borings in the cupola. Ills. 2000 w. Foundry—Jan., 1911. No. 19905.

See also Chips, and Chip Briquettes, under MACHINE WORKS AND FOUNDRIES.

Cutting Metals.

The Heat Generated in the Process of Cutting Metal. H. I. Brackenbury and G. M. Meyer. Investigates the rise of temperature quantitatively of chips when the cutting speed is increased, and considers the temperature of the work from which the chips have been removed. 2000 w. Engng—Jan. 13, 1911. No. 20510 A.

Cutting Tools.

External Cutting Tools. Douglas T. Hamilton. Illustrated detailed description of the construction and use of each tool, the various parts, functions and applications. The practice for the Brown & Sharpe automatic screw machine. 2500 w. Mach, N. Y—Jan., 1911. Serial. 1st part. No. 19878 C.

Heat Treatment of High-Speed Tools. C. P. Berg. A discussion of the relation

between temperature and life of tools. Ills. Also discussion. 7500 w. Jour W Soc of Engrs—Dec., 1910. No. 20554 D.

Dies.

Metals Inserted into Die Castings. H. C. Skinner. Illustrates and describes methods employed to give greater strength to certain parts. 1000 w. Am Mach—Jan. 19, 1911. No. 20368.

Making Dies for Drop Forgings. S. G. Hollander. Suggestions of service in die sinking. Ills. 3000 w. Am Mach—Jan. 19, 1911. No. 20367.

Forging.

See Shop Design, under MACHINE WORKS AND FOUNDRIES.

Foundries.

The Columbia Steel Foundry Illustrates and describes details of a recently opened Pacific Coast open-hearth steel castings plant. 1200 w. Ir Age—Jan. 12, 1911. No. 20114.

Job Shop for Light Steel Castings. Illustrated description of the plant of the West Steel Casting Co. at Cleveland, O., which specializes in the production of converter and crucible steel castings. 2500 w. Foundry—Jan., 1911. No. 19903.

Continuous Cast Iron Pipe Foundry. Illustrates and describes a straight floor system for the continuous production of water pipe, the cycle of operations and method of making cores. 6000 w. Foundry—Jan., 1911. No. 19902.

Foundry Appliances.

Scientifically Designed Gaggers and Their Use. Reports experiments made with old and new forms of foundry gaggers. Ills. 2000 w. Castings—Jan., 1911. No. 20281.

Foundry Design.

A Proposed Malleable Castings Plant. Gives the layout, construction and arrangement of equipment in a customs foundry. 2000 w. Ir Age—Jan. 5, 1911. No. 19921 D.

Foundry Furnaces.

Combustion in Foundry Furnaces (Die Verbrennung beim Betriebe von Giessereiflammöfen). Erich Rosenberg. A discussion of fuel consumption and economy in coal-fired furnaces. Ills. 2700 w. Stahl u Eisen—Dec. 7, 1910. No. 20445 D.

Foundry Practice.

The Progress of Mechanical Engineering in the Foundry. George K. Hooper. Illustrated review of recent improvements, with special reference to the "continuous pouring" or "mechanical handling" system. 2200 w. Ir Age—Jan. 5, 1911. No. 19923 D.

Metallurgy in the Foundry. Discusses the working up of scrap, and the mixing of irons for different sources. 2000 w. Prac Engr—Jan. 13, 1911. No. 20505 A.

Recent Tendencies in the Foundry Industry. Dr. R. Moldenke. Remarks on the increasing use of machinery, especially in molding. 2000 w. Ir Age—Jan. 5, 1911. No. 19919 D.

Ornamental Castings Made in Permanent Molds. R. Hastings Probert. Details of practice are illustrated and described. 2000 w. Ir Age—Jan. 5, 1911. No. 19920 D.

See also Cast Iron, under MATERIALS OF CONSTRUCTION.

Gear Cutting.

Hobbing Helical or Spiral Gears. Instructions for setting up and running the Gould & Eberhardt gear hobber. 1800 w. Am Mach—Jan. 19, 1911. No. 20366.

Ins and Outs of Gear Hobbing. Ralph E. Flanders. An account of experiments carried out to obtain accurate information of the hobbing process of cutting gears, discussing the results. Ills. 5500 w. Mach, N Y—Jan., 1911. No. 19881 C.

The Production of Spiral Gears (Die Herstellung der Schraubenräder). W. Dohrn. A review of methods, with many practical numerical data. Ills. Serial. 1st part. 2900 w. Zeitschr f Werkzeug—Dec. 25, 1910. No. 20478 D.

Grinding.

Modern Abrasives. George N. Jeppson. Read before the Soc. of Auto Engrs. Illustrated discussion of grinding wheels and the abrasives used. 2000 w. Automobile—Jan. 19, 1911. No. 20355.

Grinding Machinery.

Grinding Machinery. C. H. Norton. Reviews the development and history of cylindrical grinding. 4500 w. Jour Cleveland Engng Soc—Dec., 1910. No. 20329 D.

The Pratt & Whitney Automatic Cylindrical Sizing Grinder. Illustrated description of a design producing rapid and accurate work. 2000 w. Ir Age—Jan. 5, 1911. No. 19912 D.

Machine Tools.

What Is a Machine Tool? T. S. Bentley. Discusses the use of the term, and the suggested definitions, advising concerted action. 3000 w. Mach, N Y—Jan., 1911. No. 19883 C.

Strength of the Counterweight Chain. Gives examples from every-day practice to analyze argued questions in machine design. Ills. 1700 w. Am Mach—Vol. 33. No. 51. No. 20218.

Schiess Machine-Tools. Illustrates and describes two large machines for turbine work, and a machine for punching teeth in saw-blades. 700 w. Engng—Jan. 13, 1911. No. 20515 A.

Metal Cutting.

See Welding, under MACHINE WORKS AND FOUNDRIES.

Milling.

See Cam Cutting, under MACHINE WORKS AND FOUNDRIES.

Milling Machines.

The Universal Milling Machines. Luther D. Burlingame. An illustrated account of how this machine was invented,

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its first uses and early successes. 2500 w. Am Mach—Jan. 5, 1911. No. 20226.

Molding.

The Making of Cast Steel Cable Drums. H. J. M'Caslin. Illustrates and describes the molding of winding drums on end and the method's possibilities in other lines of foundry work. 1500 w. Castings—Jan., 1911. No. 20280.

Molding Air-Cooled Cylinders. Illustrated detailed description. 600 w. Am Mach—Jan. 12, 1911. No. 20230.

Pattern Shops.

Wood-Drying Plants for Pattern Shops (Holztrockenanlagen für Modelltischlereien). F. A. Luhr. Discusses the lay-out and equipment of such plants and their cost. Ills. 2000 w. Giesserei-Zeit—Dec. 1, 1910. No. 20449 D.

Pipe Drawing.

A Modern Seamless Tube Manufacturing Plank. Plan and illustrated description of a new mill in Milwaukee, Wis. 2200 w. Ir Trd Rev—Jan. 26, 1911. No. 20626.

Pipe Founding.

The Continuous Manufacture of Cast Iron Pipe. A. O. Backert. A continuous molding and casting plant at Scottdale, Pa., is illustrated and described. 4500 w. Ir Trd Rev—Jan. 5, 1911. No. 19948 D.

See also Foundries, under MACHINE WORKS AND FOUNDRIES.

Pipe Manufacture.

Improved Machine for the Manufacture of Helically-Const ucted Metallic Tube. Illustrates and describes improvements invented by Arthur Judge, including feed rollers and tapering rollers in the coiling chamber, the use of hot-air blasts for returning excess of solder to the bath, and a mechanism for cutting off tubes without stopping the travel. 1500 w. Prac Engr—Dec. 30, 1910. No. 20083 A.

Planers.

Manufacturing a Planer Feed Gear. F. A. Stanley. Illustrated description of a new form of feed gear for planers in which the parts are all self-contained and inclosed in the body of the device. 1500 w. Am Mach—Vol. 33. No. 52. No. 20222.

Pneumatic Machines.

Pneumatic Press for Removing Spring Bands. S. Wheal. Illustrated detailed description of machine designed and built at Springfield, Ill. 500 w. Mach, N Y—Jan., 1911. No. 19882 C.

Riveting Machines.

The Production of Built-Up Members (Ueber die Herstellung eiserner Tragwerke). Describes machines for boring rivet holes and rivetting machines of various types. Ills. 6600 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 31, 1910. No. 20485 D.

Sheet-Metal Working.

Forming Screw Conveyer Flights. Otto S. Beyer. Illustrated description of a method of solving a problem in sheet metal work. 1500 w. Am Mach—Jan. 12, 1911. No. 20231.

Shop Appliances.

Tools Used for Fire Engine Work. F. A. Stanley. Illustrates and describes useful tools and special appliances. 800 w. Am Mach—Jan. 19, 1911. No. 20369.

Some Jig and Fixture Designs. Franklin D. Jones. Illustrates and describes examples from the tool designing department of the Taft-Pierce Mfg. Co. 2500 w. Mach, N Y—Jan., 1911. No. 19884 C.

Shop Design.

Modern Machine Shops and Individual Plants. Charles Day. Last article of a series on the planning and building of industrial plants, illustrating and describing types and examples. 3000 w. Engineering Magazine—Feb., 1911. No. 20681 P.

Forge Shop Design and Arrangement. Warren H. Miller. Illustrated suggestions for efficiency. 1800 w. Am Mach—Vol. 33. No. 51. No. 20220.

Shop Practice.

Some Time-Saving Arrangements. W. Burns. Illustrates and describes practical shop devices and their uses. 1200 w. Cassier's Mag—Jan., 1911. No. 20305 B.

Die Work for Vacuum Cleaner Parts. S. B. Redfield. Illustrates and describes some of the many interesting dies and punches used to produce the parts. 1800 w. Am Mach—Vol. 33. No. 51. No. 20217.

Notes on Making Sheffield Cutlery. A. L. Haas. Describes primitive hand methods still used. 1200 w. Am Mach—Jan. 19, 1911. No. 20365.

Manufacture of a Bottle Cap. Illustrates and describes details of its production and attachment. 1500 w. Am Mach—Jan. 5, 1911. No. 20228.

Making Auto Motors and Parts. E. F. Lake. Illustrates and describes machinery methods in a Detroit shop. 1500 w. Am Mach—Jan. 19, 1911. No. 20364.

Building a Steam Fire Engine. F. A. Stanley. Illustrates and describes interesting construction work. 1800 w. Am Mach—Jan. 5, 1911. No. 20225.

A Vertical Boring-Mill Operation. Descriptive supplement and notes on the turning of a flywheel. 2000 w. Mach, N Y—Jan., 1911. No. 19885 C.

Shops.

Machine and Boiler Shops of Improved Construction. Illustrated description of features of recent additions to the plant of the York Mfg. Co., at York, Pa. 3500 w. Ir Age—Jan. 19, 1911. No. 20279.

Welding.

Metal-Cutting and Welding Blow-Pipes. Illustrates and describes appli-

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ances at Olympia Exhibition. 1200 w. Engng—Jan 6, 1911. No. 20264 A.

The Strength of Oxy-acetylene Welds in Steel. L. Whittemore. Abstract of a thesis describing work to ascertain their physical properties. Ills. 4000 w. Wis Engr—Jan., 1911. No. 20325 C.

See also Boiler Repairs, under STEAM ENGINEERING.

MATERIALS OF CONSTRUCTION.

Alloys.

Monel Metal and Its Uses. John F. Thompson. A natural alloy used for warship propellers, roofs of buildings, mine screens, etc. 1500 w. Eng & Min Jour—Jan. 28, 1911. No. 20645.

The Production of Castings to Withstand High Pressures. Prof. H. C. H. Carpenter and C. A. Edwards. An illustrated account of investigation of the production of castings of non-ferrous alloys capable of withstanding high pressures, whether hydraulic, steam, or gaseous. 10000 w. Inst of Mech Engrs—Dec. 16, 1910. No. 19971 N.

Bronzes.

Notes on Bronzes and Other Copper Alloys (Einiges über Bronzen und andere Kupferlegierungen). A. Rzehulka. Discusses their composition for various purposes, their properties, etc. 7800 w. Glasers Ann—Dec. 15, 1910. No. 20475 D.

Cast Iron.

Improved Cast Iron and How to Get It in the Foundry. F. P. Lewis. Read before the British Foundrymen's Assn. Discusses how the quality of cast iron may be improved and its use extended. 5000 w. Castings—Jan., 1911. No. 20282.

Heat Treatment.

Heat and Cooling Treatment. James H. Baker. Shows the benefits of iron and steel heat treatment, the principle underlying the process, suggestions as to appliances, etc. 4000 w. Am Mach—Jan. 5, 1911. No. 20227.

Malleable Iron.

Malleable Annealing Experiments. S. B. Chadsey. Illustrated report of tests made to ascertain the effect upon physical properties of malleables subjected to successive annealing. 2000 w. Foundry—Jan., 1911. No. 19904.

Metallography.

The Utility of the Metallographic Microscope in Engineering. James Arston. Discusses its use in the examination of steels and other industrial alloys, giving examples of its application to special problems. Ills. 2000 w. Wis Engr—Jan., 1911. No. 20326 C.

The Constitution of Troostite and the Tempering of Steel. Andrew McCance. Report of research work at the laboratories of the Royal School of Mines. Ills. 5000 w. Inst of Mech Engrs—Dec. 16, 1910. No. 19976 N.

Application of the Method of Thermic Analysis to Ternary Alloys (Application de la Méthode d'Analyse thermique aux Alliages ternaires). A. Portevin. An extension of the Tammann method to ternary alloys. Ills. 2500 w. Rev de Métal—Dec., 1910. No. 20407 E + F.

Steel.

Electro Steel. Joseph Schaeffers. Read before the Soc. of Auto. Engrs. Points out the characteristic of electricially refined steel from the viewpoint of an automobile engineer. Ills. 2500 w. Automobile—Jan. 12, 1911. No. 20192 C.

Wire Rope.

A Large Wire Rope of Unusual Construction for a Cable Incline of the Mayari R. R., Cuba. Frank W. Bunn. Detailed description of a rope 3 ins. in diameter. Ills. 1000 w. Eng News—Dec. 29, 1910. No. 19794.

MEASUREMENT.

Dynamometers.

Brake Dynamometers. Explains brake tests made for determining the effective horsepower of an engine. Ills. 2000 w. Mech Wld—Jan. 13, 1911. No. 20508 A.

Laboratories.

Laboratory of Ludwig Loewe & Co. Bertold Mitan. Describes the first laboratory established by a machinery-buiding firm in Europe. Ills. 2500 w. Am Mach—Jan. 26, 1911. No. 20603.

Lubricant Testing.

Testing of Lubricating Oils. David L. Gallup. Describes tests made with the Kingsbury oil testing machine, with particular reference to oils used in the automobile engine. Ills. 2000 w. Jour Worcester Poly Inst—Jan., 1911. No. 20320 C.

Pressure Indicator.

Pressure-Recording Indicator for Punching Machinery. Gardner C. Anthony. Describes a device for obtaining cards from an ordnance indicator applied to a pressure cylinder, which enables the operator to obtain results as easily and rapidly as in indicating an engine. Ills. 1000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20574 F.

Pyrometry.

Industrial Pyrometry. Charles R. Darling. Brief review of the history of temperature measurement with a study of modern pyrometers. Ills. 3500 w. Jour Soc of Arts—Dec. 23, 1910. No. 19953 A.

Checking Pyrometers in Service. R. W. Davenport. Describes the construction and operation of pyrometers, and means of detecting and correcting errors. 1500 w. Am Mach—Jan. 12, 1911. No. 20235.

Electric Pyrometers (Les Pyromètres électriques). H. Marchand. A review of the various types. Ills. 2700 w. L'Elecn—Dec. 17, 1910. No. 20419 D.

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Steam Meters.

Exhibition and Description of Steam Meter. W. G. McKellar. Illustrated description, with discussion. 2000 w. Jour W of Scotland Ir & St Inst—Nov., 1910. No. 20311 N.

Stresses.

Photo-Elasticity. E. G. Coker. An illustrated report of experiments on the optical determination of stresses in bodies and built-up structures. Plate. 6000 w. Engng—Jan. 6, 1911. No. 20260 A.

Testing Machines.

A New Impact Testing-Machine. D. R. MacLachlan. Illustrated description of a machine for testing materials by direct tension, suddenly applied, recently completed at the Woolwich Polytechnic. 1500 w. Engng—Dec. 23, 1910. No. 19974 A.

Torsion Meters.

The Eotvos-Hecker Torsion-Balance. Diagrams and description of this instrument. 2000 w. Engng—Jan. 13, 1911. No. 20516 A.

Water Meters.

The Woltmann Water Meter (Der Woltmann-Wassermesser). Herr Hache. Describes the meter and reports results of tests. Ills. 3600 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20709 D.

POWER AND TRANSMISSION.

Air Compressors.

See Engine Design, under STEAM ENGINEERING.

Costs.

Graphical Representation of Power Costs (Graphische Veranschaulichung der Rentabilität von Maschinen). H. Goetz. A graphical comparison of direct and indirect costs for electric motors and gas and oil engines for various periods of operation. Ills. Serial. 1st part. 2000 w. Zeitschr f Werkzeug—Dec. 15, 1910. No. 20477 D.

Electric Driving.

Electrical Driving of Engineering Workshops. C. L. Browne. The advantages and disadvantages are discussed, as compared with mechanically driven shops. 1800 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20257 A.

Electricity in the Machine Shop. C. W. Johnson. Read before the Met. Trds. Supts. & Foremen's Club. Information concerning its applications and the savings expected by its use. 3000 w. Ir Age—Jan. 26, 1911. No. 20600.

Trend of Electric Power Application in the Iron and Steel Industry. R. Tschentscher. Discusses the trend of future development in electric application, sources of waste heat, etc. 1500 w. Elec Rev & W Elect'n—Jan. 7, 1911. No. 20052.

Electric Driving of Textile Machinery. Illustrated description of the power plant of the Ray Mills, at Stalybridge. 2000 w. Elec Rev, Lond—Dec. 23, 1910. No. 19959 A.

Recent Developments in Textile Mill Design and Operation: Notably as Regards Electrification. L. Crouch. Notes on four groups of American textile mills, representing a total capacity of 17,000 kw., driving some 528,000 spindles and 19,400 looms. 2200 w. Elec Rev, Lond—Dec. 23, 1910. Serial. 1st part. No. 19958 A.

Gas Power.

Gas Power Development. James Rowland Bibbins. Reviews what has been accomplished, and discusses the future applications in undeveloped fields. 4500 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20575 F.

Some Pertinent Features Relating to Gas Power. E. D. Dreyfus. Discusses the fundamental features, the fields of usefulness, the gases for operation, types of gas engines, etc. Ills. 7000 w. Pro Ry Club of Pittsburgh—Nov. 25, 1910. No. 20318 C.

Lubricants.

See Lubricant Testing, under MEASUREMENT.

Lubrication.

The Lubrication of Ball Bearings. W. L. Batt. Discusses the requirements, and illustrates examples of mountings for ball bearings designed to retain lubricants. 1500 w. Am Mach—Jan. 12, 1911. No. 20236.

See also Turbine Lubrication, under STEAM ENGINEERING.

Power-Plant Records.

Keeping Power Plant Records. Warren O. Rogers. Illustrates and describes a complete system of daily, weekly, and monthly reports. 1500 w. Power—Jan. 24, 1911. No. 20390.

Power Plants.

Features of Plant at Kodak Park Works. A. R. Maujer. Brief description of interesting features of this plant at Rochester, N. Y. Ills. 1200 w. Power—Jan. 17, 1911. No. 20213.

See also Steel, under CIVIL ENGINEERING, CONSTRUCTION; and Isolated Plants, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Wave Motors.

New Wave Motor of the Float Type. A. R. Maujer and Franklin Van Winkle. An estimate of the U. S. Wave Power Co.'s motor installed on Young's "Million-dollar" pier, at Atlantic City, N. J. Ills. 2500 w. Power—Jan. 17, 1911. No. 20215.

Windmills.

A Nantucket Windmill of 1746 Still in Operation. Allen Day. Illustrated account of how the Dutch windmill was introduced into New England, with description of the mill mentioned. Ills. 1500 w. Sci Am—Jan. 28, 1911. No. 20640.

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STEAM ENGINEERING.

Boiler Design.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Boiler Economy.

Boiler Economics and the Use of High Gas Speeds. Prof. John T. Nicolson. Gives an account of results obtained with an experimental boiler, discussing the bearing of the newly-obtained data on boiler practice. Ills. 19600 w. Inst of Engrs & Shipbldrs in Scotland—Dec. 20, 1910. No. 20525 N.

Boiler Explosions.

Water Hammer and Boiler Explosions. A. Vincent Clark. Gives theories of the cause of such explosions, explaining their violence. 1700 w. Power—Jan. 10, 1911. No. 20103.

Boiler Firing.

Stoking with Cheap Fuel. G. Basil Barham. Suggestions for successful stoking with various cheap fuels. 2000 w. Elec Engr, Lond—Jan. 6, 1911. No. 20245 A.

Boiler Management.

Increasing the Capacity of Boilers. H. R. Callaway. Explains how the capacity of a horizontal boiler may be increased approximately 300 per cent. 1700 w. Power—Jan. 24, 1911. No. 20392.

Notes and Comments on Boiler Working. C. E. Stromeyer. From the memorandum of the Chief Engr. of the Manchester Steam Users' Assn. for the year 1909. 6000 w. Mech Engr—Dec. 30, 1910. Serial. 1st part. No. 20086 A.

Hudson Manhattan Power Station. F. R. Low. Illustrates and describes the boiler-room practice in this Jersey City plant which produces current for the operation of the trains in the McAdoo tunnels at less than 0.42 of a cent per kw-hour and makes 1000 lbs. of steam with 12.5 cents worth of coal. 1700 w. Power—Jan. 17, 1911. No. 20212.

Boiler Repairs.

Flue Welding in Repairing Boilers. H. S. Jeffrey. Tells how to weld boiler tubes which are cut during the process of removal. Ills. 1100 w. Power—Jan. 17, 1911. No. 20216.

Boiler Settings.

Setting Horizontal Tubular Boilers. S. F. Jeter. Gives directions for constructing the setting, and dimensions of different parts of the setting for various sizes of boilers. Ills. 4000 w. Power—Jan. 3, 1911. No. 19886.

Boiler Tubes.

Stresses in Tubes. Prof. Reid T. Stewart. An investigation showing that the stresses in the wall of a tube exposed to an external fluid pressure are of the same character as those in a column having fixed ends. Mathematical. 1800 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20572 F.

Boiler Washing.

See Locomotive Boilers, under RAILWAY ENGINEERING, Motive Power and Equipment.

Condensers.

Jet v. Surface Condensers. R. M. Neilson. Considers the surface condenser and the barometric jet condenser, aiming to show where each may be profitably employed in conjunction with steam turbines employing either high- or low-pressure steam. 3500 w. Engr, Lond—Dec. 23, 1910. No. 19977 A.

Notes on Condensing. Types of condensers are explained and the principles of operation which are essential for efficient running. 2000 w. Mech Wld—Jan. 6, 1911. Serial. 1st part. No. 20255 A.

Recent Types of Condensers (Neuere Condensator-Typen). Fr. Bock. Describes recent advances in European condenser design. Ills. Serial. 1st part. 1500 w. Elektrotech Rundschau—Dec. 22, 1910. No. 20490 D.

Economizers.

Economizer Utility. Abstract translations giving the main substance of papers by Herr Kaufhold, and Herr M. R. Schulz. Ills. 2500 w. Engr, Lond—Dec. 30, 1910. No. 20096 A.

Engine Compression.

The Effect of Compression on the Economy of the Steam Engine. R. C. Carpenter. Considers the theoretical and actual effects of compression, reporting tests and giving diagrams. 4500 w. Sib Jour of Engng—Dec., 1910. No. 20336 C.

Compression in Steam Engines. Armand Duchesne. Discusses the effect of compression on efficiency. 2000 w. Power—Jan. 10, 1911. No. 20106.

Engine Cylinders.

The Influence of the Cylinder Wall. Prof. V. Dwelshauvers-Dery. Shows that the thermal influence of the cylinder walls depends very little upon the size of the machine and very much on the conditions of operation. 3500 w. Power—Jan. 3, 1911. No. 19890.

Engine Design.

Engine and Compressor Power Charts. T. M. Chance. Gives three charts for determining the required dimensions for a given power, or vice versa, of a steam or gas engine, or air compressor. 1100 w. Power—Jan. 17, 1911. No. 20214.

Engine Reheaters.

Engines with Reheaters. A. C. Wilson. Read before the Manchester Univ. Engng. Soc. Deals with compressed steam engines arranged for imparting heat to the working fluid after it has done work in the high-pressure cylinder. Reports tests and conclusions. 3000 w. Mech Engr—Dec 23, 1910. No. 19964 A.

Engines.

600- I. H.-P. Compound Engine. Illustrated description of an engine fitted

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with Carels balanced drop-valves, and designed for limited space. Plate. 600 w. Engng—Dec. 30, 1910. No. 20092 A.

Engine Valve Gears.

A Slowly Moving Positive Valve Gear. Dr. Alfred Gradenwitz. Illustrated description of an engine having separate steam and exhaust valves of the piston type arranged tangentially to the cylinder and operated by eccentrics on a lay shaft. 1500 w. Power—Jan. 10, 1911. No. 20102.

A Geometrical Study of the Corliss Valve Gear (Etude géométrique de la Distribution des Machines à Vapeur à Distributeurs séparés). L. Letombe. A complete solution of gears of this type by means of rule and compass. Ills. 2800 w. Mem Soc Ing Civ de France—Oct., 1910—No. 20401 G.

Fuel Purchasing.

The Purchase of Coal by the Government Under Specifications, with Analyses of Coal Delivered for the Fiscal Year 1908-9. George S. Pope. Shows the results of government purchases according to specifications as to quality, with general information. 17500 w. U S Bureau of Mines—Bul II. No. 20672 N.

Mechanical Stokers.

Automatic Stokers Which Throw Coal. F. R. Low. Illustrated descriptions of various types used in Europe. 1800 w. Power—Jan. 24, 1911. No. 20391.

Oil Separators.

Separation of Oil from Condenser Water by Electrolysis. Ridsdale Ellis, Abstract of paper read before the Soc. of Chem. Ind. Describes the Davis-Perrett oil separator, giving particulars of the efficiency and cost of operation. Discussion. 2800 w. Elect'n, Lond—Dec. 30, 1910. No. 20081 A.

Plant Design.

Design of Steam Power Plants. William F. Fischer. Discusses the factors to be considered. 2000 w. Power—Jan. 24, 1911. No. 20393.

Smoke Prevention.

Smoke Prevention. General discussion. 7000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20578 D.

Smoke and Its Prevention. Vivian B. Lewes. A lecture delivered at the London Inst. Explains details of the chemical and physical action during combustion of bituminous coal, and the causes that give rise to smoke, reviewing the proposals made for its prevention. Considers the best solution is low-temperature carbonization and the production of such fuels as coalite. 7000 w. Nature—Dec. 29, 1910. No. 20072 A.

Device for Preventing Smoke. W. H. Odell. Illustrated description of a device using a hot blast to aid in the combustion of the fuel. 1200 w. Power—Jan. 10, 1911. No. 20105.

Needle Jets of Superheated Steam to Prevent Smoke: the Luckenbach Boiler Furnace. Illustrated description of the Luckenbach system. 800 w. Eng News—Dec. 29, 1910. No. 19795.

Investigations of Smokeless Combustion in the Karlsbad Municipal Plants (Versuche mit rauchschwachen Feuerungen in den städtischen Betrieben in Karlsbad). Rud. Grund. A brief review of the experience of the last 5 years. Ills. 2200 w. Oest Zeitschr f d Oeffent Baudienst—Dec. 10, 1910. No. 20483 D.

Stacks.

See same title, under CIVIL ENGINEERING, CONSTRUCTION.

Steam Piping.

A Simple Method of Determining Sizes of Pipes for Low-Pressure Steam-Heating. F. E. Giesecke. Diagrams and explanation, illustrated by problems, and giving related information. 3500 w. Dom Engng—Jan. 14, 1911. No. 20117.

Superheaters.

Modern Steam Superheaters. Warren O. Rogers. General illustrated description of American superheaters, dealing with features of design and application. 3500 w. Power—Jan. 3, 1911. No. 19888.

Turbine Bibliography.

Turbine Literature in 1909 (Jahreszeitschriftenschau von 1909). Herr Niemann. A bibliography of turbine literature in 198 publications, covering steam, water and gas turbines, centrifugal pumps and compressors, fans, and rotary engines. Serial. 1st part. 9600 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1910. No. 20469 D.

Turbine Blades.

Tests and Experience with Turbine Blades in the German Navy (Versuche und Erfahrungen mit Turbinenschaufeln in der deutschen Kriegsmarine). Herr Schulz. A complete exposition of blade practice and of the knowledge gained. Ills. Serial. 1st part. 9000 w. Die Turbine—Dec. 5, 1910. No. 20465 D.

Turbine Governing.

The Governing of Steam Turbines (Die Regulierung von Dampfturbinen). Describes the methods and devices used for governing A. E. G. turbines. Ills. Serial. 1st part. 1400 w. Zeitschr f d Gesamte Turbinenwesen—Dec. 20, 1910. No. 20468 D.

Turbine Losses.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. A study of the losses which occur in turbines of the Curtis and Rateau types. Ills. 2000 w. Power—Jan. 3, 1910. No. 19889.

Turbine Lubrication.

Gravity Turbine Oiling System. Hugh Hughes. Illustrates and describes the design and operation of a system for the Curtis vertical turbine. 1800 w. Power—Jan. 3, 1911. No. 19887.

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Turbines.

The Steam Turbine in Germany. F. E. Junge and E. Heinrich. Discusses combination turbines built on Curtis and Rateau principles. Ills. 1600 w. Power—Jan. 10, 1911. No. 20104.

5000-Kilowatt Rateau Steam Turbines at the Greenwich Power Station. Drawings and description. 3500 w. Engng—Jan. 13, 1911. No. 20511 A.

Advantages, Operating Conditions, and Applications of Small Exhaust Steam Turbines. A. Eugene Michel. Illustrates and describes a Kerr exhaust turbine generator installation, explaining its advantages. 2200 w. Can Engr—Dec. 29, 1910. No. 19850.

TRANSPORTING AND CONVEYING.

Cableways.

Cableways Built by the Peniger Maschinenfabrik und Eisengiesserei A. G. (Kabelhochbahnkrane gebaut von der Peniger Maschinenfabrik und Eisengiesserei A.-G.). M. Buhle. Describes a type of single-span cableway. Ills. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 31, 1910. No. 20710 D.

See also Coal Handling, under TRANSPORTING AND CONVEYING.

Coal-Handling.

Electricity in Gas Works. Dr. Alfred Gradenwitz. Illustrates and describes the application of electric motors to coal-handling machinery. 800 w. Sci Am Sup—Dec. 31, 1910. No. 19790.

Transporting Methods in Modern Coal Mines. Dr. Alfred Gradenwitz. Illustrates and describes some model plants using electric cableways. 2000 w. Min Wld—Jan. 7, 1911. No. 20064.

Cranes.

25-Ton Steam Travelling Crane. Illustrated description of a crane for harbor works at Singapore. 500 w. Engng—Jan. 13, 1911. No. 20513 A.

Magnet Cranes (Magnetkrane). C. Michenfelder. Describes a number of steel-works and foundry magnet cranes. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—Dec. 3, 1910. No. 20703 D.

Elevators.

The Accurate Stopping of Elevators (Ueber das genaue Halten der Fahrstühle). Carl Gruber. Discusses means for bringing elevators gently and accurately to rest at all loads. Ills. Serial. 1st part. 2200 w. Elektrotech Rundschau—Dec. 29, 1910. No. 20491 D.

Freight Handling.

The Mechanical Handling of Freight. Samuel B. Fowler. Full discussion of the problem showing its effect on the whole transportation question, its cost and efficiency. 8800 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20571 F.

See also Steel, under CIVIL ENGINEERING, CONSTRUCTION.

Hoisting Machinery.

Electrically Operated Hoisting Machinery (Les Appareils de Levage à Commande électrique). G. Dehenne. Considers the advantages of electrical operation for hoisting machinery of all types, reviewing present practice. Ills. 1200 w. Mem Soc Ing Civ de France—Oct., 1910. No. 20400 G.

Lifting Magnets.

The Practical Application of Lifting Magnets. H. F. Stratton. Discusses the design and construction of magnets, referring to the character of the service they encounter. Ills. 3000 w. Sib Jour of Engng—Dec., 1910. No. 20334 C.

See also Cranes, under TRANSPORTING AND CONVEYING.

Mail Handling.

Mail-Handling Plant at the Pennsylvania Terminal. Joseph B. Baker. Illustrates and describes a unique electric-diriven mechanical-transport installation. 3500 w. Engineering Magazine—Feb., 1911. No. 20680 B.

Mail-Handling Plant in a New York Post Office. Joseph B. Baker. Illustrated description of the electrically operated plant in the Pennsylvania R. R. Station, handling nearly 300 tons of mail daily. 3000 w. Elec Rev & W Elect'n—Jan. 21, 1911. No. 20382.

MISCELLANY.

Guns.

The Stiffness of Guns. H. J. Jones. A study of the comparative stiffness of modern built-up, solid and wire-wound guns, and the initial unsteadiness of projectiles. 4000 w. Engng—Dec. 30, 1910. No. 20090 A.

Special Artillery for Attacking Airships and Aeroplanes (L'Artillerie spéciale contre les Dirigeables et les Aéroplanes). G. Espitallier. Describes guns and projectiles developed for this purpose in France. Ills. 3500 w. Génie Civil—Dec. 17, 1910. No. 20428 D.

Paper-Making Machinery.

A Large Paper-Making Machine. F. C. Coleman. Illustrations and brief description of machinery recently made for the paper mills of the "Daily Telegraph" of London. 1500 w. Sci Am Sup—Jan. 7, 1911. No. 19943.

Recording Clocks.

Time-Recording and Signalling Apparatus. An illustrated review of the leading types of instruments of this kind on the markets. 500 w. Mech Engr—Dec. 23, 1910. Serial. 1st part. No. 19963 A.

Vacuum Cleaning.

Vacuum Cleaning in Federal Buildings. M. S. Cooley and Nelson S. Thompson. Describes the stationary vacuum cleaning systems used in post office and other treasury department buildings. 2000 w. Met Work—Jan. 7. 1911. Serial. 1st part. No. 19988.

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MINING AND METALLURGY

COAL AND COKE.

Accidents.

Fatal Accidents in the Coal Mines of North America. Frederick L. Hoffman. Gives statistics and discusses the improvements needed to lessen the fatalities. 3000 w. Eng & Min Jour—Dec. 31, 1910. No. 19866.

Australia.

Ipswich Coal and Coke Syndicate's Property, Tivoli, Near Ipswich. W. E. Cameron. Map and description of coal deposits in Queensland. 1500 w. Queens Gov Min Jour—Dec. 15, 1910. No. 20243 B.

New South Wales Collieries and Electricity. E. Kilburn Scott. Abstract of paper read before the Assn. of Min. Elec. Engrs. Information concerning the colliery districts and their mining methods, and the inquiry into the use of electricity. 5000 w. Elec Engr, Lond—Jan. 13, 1911. No. 20398 A.

British Columbia.

The Classification of Nicola Valley Coals. S. J. Castleman. Gives reports of analyses made and coking quality which show them to be bituminous coals. 700 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20535 N.

Cape Breton.

Dominion No. 2 Colliery of the Dominion Coal Company. A. G. Haultain. Describes mining methods on Cape Breton Island. Ills. 3000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20539 N.

Coking Plants.

A New By-Product Coking Plant in the South. The modern method of coke-making at the Woodward Iron Company's works is illustrated and described. 3500 w. Ir Trd Rev—Jan. 5, 1911. No. 19951 D.

Drying.

See same title, under ORE DRESSING AND CONCENTRATION.

Electric Power.

Electricity Applied to Mining. C. F. Jackson. Lecture delivered before the Coventry Eng. Soc. Briefly considers the applications of electric power in mines. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20275 A.

The Earthed Concentric System for Direct-Current Colliery Cables. W. Bolton Shaw. Read before the Inst. of Min. Elec. Engrs. Presents the advantages of this system and discusses the precautions to be observed when installing it. 4000 w. Mech Engr—Jan. 6, 1911. No. 20253 A.

The Use of "Earth" in Connection with Electricity in Mining. Sydney F. Walker. The present article discusses the question of earthing with continuous-current supply service. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. Serial 1st part. No. 20274 A.

Flame-Proof Motors for Colliery Work. Illustrated description of a motor specially designed for mining requirements. 600 w. Engng—Jan. 6, 1911. No. 20267 A.

Production and Utilization of Electrical Energy at the Lens Mines (Production et Utilisation de l'Energie électrique aux Mines de Lens). M. Besson. Describes the use of coke-oven gas under boilers and in gas engines, and the utilization of exhaust steam. Ills. 5600 w. Bul Soc Int d'Elecns—Dec., 1910. No. 20403 F.

See also Australia, under COAL AND COKE.

Explosions.

Coal-Dust Explosions. Comments on research work, particularly in France, and the conclusions thus far reached. 4500 w. Engng—Jan. 6, 1911. No. 20266 A.

The Delagua, Colo., Explosion. George F. Duck. An illustrated account of conditions at the mine before and after the explosion. 5000 w. Mines & Min—Jan., 1911. No. 19901 C.

Great Britain.

The Nottingham Coalfield. Information from a memoir on the geology of the country recently issued by the Geological Survey. 5000 w. Col Guard—Dec. 30, 1910. No. 20089 A.

Illinois.

The Illinois Coal Industry. Frank W. DeWolf. Review of the past year, the strike, etc. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20153.

Mine Drainage.

Draining a Flooded Goaf. J. R. Wilkinson. Read before the Nat. Assn. of Col. Mgrs. An illustrated account of an experience resulting in failure. 2000 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20273 A.

Mine Dust.

The British Coal-Dust Experiments. Editorial review of the experiments carried out on behalf of the Mining Assn. of Gt. Britain. 3000 w. Engng—Dec. 23, 1910. No. 19975 A.

Coal Dust Experiments. Sir Henry Hall. Abstract of a paper read before the Manchester Geol. & Min. Soc. Comments on the recent British, Continental and American coal dust experiments. 6000 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20524 A.

French Experiments on Coal Dust. Henry Briggs. A discussion of the results of these experiments. 4000 w. Eng & Min Jour—Jan. 21, 1911. No. 20363.

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Coal-Dust Experiments in Austria. A detailed summary of a report of the second series of experiments in the Rossitz gallery, with editorial comment. Ills. 3000 w. Col Guard—Dec. 30, 1910. No. 20088 A.

Mine Lighting.

The Installation of Electric Lighting in Collieries. P. D. Coates. An outline of what the writer considers the best method of procedure. 1500 w. Ir & Coal Trds Rev—Jan. 6, 1911. No. 20276 A.

Mining.

American vs. European Mining. Dr. Henry M. Payne. Address before the Appalachian Engng. Assn. A comparison of methods in the European countries with American methods. 1800 w. Mfrs' Rec—Jan. 5, 1911. No. 19993.

Mining Law.

The Mine Law of West Virginia. P. A. Grady. Read before the W. Va. Coal Min. Inst. Shows that those most successful in the production of coal do better than the law requires. 3000 w. Mines & Min—Jan., 1911. No. 19900 C.

Pennsylvania.

Model Coal Mines at Marianna. A. C. Beeson and Floyd W. Parsons. First of a series of articles giving detailed descriptions of most modern coal operation in America. Ills. 2000 w. Eng & Min Jour—Jan. 21, 1911. Serial. 1st part. No. 20361.

Prospecting.

Prospecting for Coal Above Water Level. Baird Halberstadt. Abstract from Trans. of the Appalachian Engng. Assn. Describes methods of prospecting, using a drill auger. 2500 w. Min Wld—Jan. 7, 1911. No. 20067.

Rescue Methods.

The History of Rescue Methods in Coal Mining (Beiträge zur Geschichte des bergmännischen Rettungswesens). Herr Hagemann. A review of the early history of rescue apparatus in England and Germany. 4200 w. Glückauf—Dec. 24, 1910. No. 20457 D.

Review of 1910.

The Coal and Coke Industry in 1910. Articles by reliable authors dealing with that industry, trade, production, etc. 9000 w. Eng & Min Jour—Jan. 7, 1911. No. 20048.

The Coal-Mining Industry of the U. S. in 1910. Edward W. Parker. A report on production of anthracite and bituminous coal. 4000 w. Min Wld—Jan. 21, 1911. No. 20376 C.

Screening.

The Design of Screening Plants for Old and Modern Collieries. J. S. Barnes. Illustrates and describes a plant recently designed by the writer, aiming to secure economy and efficiency. Plate. 1500 w. Engr, Lond—Dec. 23, 1910. Serial. 1st part. No. 19979 A.

Trade.

The Coal Trade in 1910. A general review by districts. Also editorial. 32500 w. Col Guard—Jan. 6, 1911. Serial. 1st part. No. 20258 A.

The Coal, Iron and Allied Trades in 1910. General and district reviews of the year's progress in these industries. 27500 w. Ir & Coal Trds Rev—Dec. 30, 1910. No. 20100 A.

Wales.

The Main Collieries, Neath. History and description. 3500 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20523 A.

COPPER.

Alaska.

Opening of the Chitina Copper Belt in Alaska. Denis Donohoe. An illustrated account of a richly mineralized region, yielding copper, free gold, and auriferous stibnite. 2000 w. Eng & Min Jour—Dec. 31, 1910. No. 19863.

Arizona.

The Ray Copper Mining District, Arizona. Walter Harvey Weed. An illustrated description of the development of low-grade deposits. 3500 w. Min Wld—Jan. 14, 1911. No. 20208.

California.

The Copper Smelting Situation in California. A. H. Martin. Discusses the decline due to the anti-smoke agitation against smelters. 3000 w. Min Wld—Jan. 7, 1911. No. 20065.

Converters.

A New Copper Converter. Illustrated description of a converter of the Pierce-Smith type. 800 w. Aust Min Stand—Nov. 23, 1910. No. 20069 B.

Metallurgy.

Review of the Metallurgy of Copper in 1910. L. S. Austin. Reviews present practice in conveying and transmission, roasting, reverberatory smelting, blast furnace operation, converter practice, etc. 3000 w. Met & Chem Engng—Jan., 1911. No. 20131 C.

The Metallurgy of Copper in 1910. Arthur L. Walker. Reviews some important developments in reverberatory practice, flue dust, smoke, refining, etc. 2500 w. Eng & Min Jour—Jan. 7, 1911. No. 20038.

Prices.

Copper Prices and the Future of the Industry. Martin E. Tew. Brief review of past and present conditions, predicting higher prices. 2000 w. Min Wld—Jan. 19, 1911. No. 20374 C.

Review of 1910.

The Copper Industry in 1910. Statistics of production, consumption, and related matter. Also articles on the more important mines, by well known engineers. 10000 w. Eng & Min Jour—Jan. 7, 1911. No. 20033.

Review of the World's Copper Trade in 1910. Horace J. Stevens. A review of

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production and prices. 3500 w. Min Wld —Jan. 21, 1911. No. 20372 C.

Production of Copper in the United States in 1910. A review by states. 1800 w. Min Wld—Jan. 21, 1911. No. 20373 C.

Copper Production in 1910 by States. Shows an output below 1909, but exceeding any other year. 1500 w. Min & Sci Pr—Jan. 14, 1911. No. 20293.

Slags.

Notes on Metal Losses in Copper Slags. Thomas Kiddie. Gives results of slag analyses. 1000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20529 N.

Smelting.

Improvements in Silver-Lead and Copper Smelting. L. S. Austin. Reviews the advances of the past year in blast-roasting of silver-lead ores, and lessening the annoyance of smoke; and the development of basic converting in copper smelting. 3000 w. Min & Sci Pr—Jan. 7, 1911. No. 20156.

Trade.

The Copper Trade in 1910. L. M. Atherton. Reviews a disappointing year. 1800 w. Ir Age—Jan. 5, 1911. No. 19917 D.

Utah.

Notes on Some Utah Mines. Edward R. Zalinski. Map, with information concerning various camps. 2200 w. Eng & Min Jour—Jan. 28, 1911. No. 20644.

GOLD AND SILVER.

Alaska.

See same title, under COPPER.

Amalgamation.

Amalgamation Following Fine Grinding. C. F. Spaulding. Describes an amalgamating device to be used with fine grinding. 1100 w. Min & Sci Pr—Dec. 31, 1910. No. 19997.

Assaying.

A Portable Assay-Outfit for Field-Work. Describes outfit and supplies for about 100 assays which could be carried in a 26-in. valise. 2500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20581 F.

Australia.

The Meekatharra Gold Mining Centre, Western Australia. H. P. Woodward. Information of the Kyarra mine district. 1500 w. Aust Min Stand—Nov. 30, 1910. No. 20070 B.

British Columbia.

In and About Stewart, B. C. W. W. Rush. Illustrated account of progress in the Portland Canal district. 1500 w. Can Min Jour—Jan. 15, 1911. No. 20353.

Silver and Gold Deposits on the West Fork of Kettle River, B. C. L. Reinecke. Brief description of the more striking features of the silver-lead deposits on Wallace Mountain, and the gold-silver property, on the West Fork of the Kettle River. 2200 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20534 N.

Portland Canal. Newton W. Emmens. Describes this district, giving its history, geology, and describing the more prominent mines and prospects. Ills. 8000 w. B C Min Rec—Nov., 1910. No. 19991 C.

Portland Canal Mining Division. Notes from the preliminary report by William Fleet Robertson. Descriptive review of this mining district and its development. 6000 w. Can Min Jour—Jan. 1, 1911. No. 19894.

California.

Gold Mining in California in 1910. William H. Storms. Illustrated review of the year, reporting a noticeable revival. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20150.

Cobalt.

Review of Mining in Cobalt During 1910. Reviews the production of the different properties and the discoveries made during the year. Map. 3800 w. Can Min Jour—Jan. 15, 1911. No. 20352.

Output of the Coniagas Mines, Ltd., 1910. Alex. Gray. Plan, flow sheet, and report of the output of silver for the year, with other information. 1500 w. Min Wld—Jan. 7, 1911. No. 20066.

Colorado.

Gold Deposits at San Juan, Colo. Warren C. Prosser. Map and description of the geology of the country, and some of the veins and mines. 3500 w. Mines & Min—Jan., 1911. No. 19897 C.

Mining in Cripple Creek District. William H. Storms. Information concerning the mines and their development. Ills. 2000 w. Min & Sci Pr—Jan. 21, 1911. No. 20628.

Cyaniding.

Review of Cyanidation in 1910. Philip Argall. Shows an advance along mechanical lines. 5000 w. Eng & Min Jour —Jan. 7, 1911. No. 20039.

Progress in Cyaniding During 1910. R. W. Gordon. Reviews improvements in details and methods resulting in reduction of cost and increase in production. 1500 w. Engng-Con—Jan., 1911. No. 20133 C.

American Progress in Cyanidation. A review of the past year showing an increased use of Pachuca vats and the process of continuous agitation, a tendency to downward heavier crushing duty, and increase in the practice of cyaniding the sulphides and vein material in the same operation. 2500 w. Min & Sci Pr—Jan. 7, 1911. No. 20157.

The Clancy Process. J. C. Clancy. Abstract of a paper the Am Elec. Chem. Soc. Describes the method of using this process for the treatment of refractory ores. 2800 w. Min & Sci Pr—Dec. 31, 1910. No. 19994.

Dredging.

Future of Dredging. Charles Janin. Briefly reviews dredging operations in va-

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rious countries, and discusses future prospects. 3500 w. Min & Sci Pr—Dec. 31, 1910. No. 19995.

Gold Dredging in California. Charles Janin and W. M. Winston. Maps and review of the work during 1910. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20154.

Nome Dredges in 1910. T. M. Gibson. Illustrates and describes dredges constructed during the past year, and the work they are expected to accomplish. 5500 w. Min & Sci Pr—Jan. 7, 1911. No. 20147.

New Klondike Dredges. Guy A. R. Lewington. Illustrates and describes Canadian No. 2, the largest gold dredge operating in the world. 1800 w. Min & Sci Pr—Jan. 7, 1911. No. 20149.

Type No. 1 of the New Era Gold Dredge. E. S. Bennett. Illustrated description. 1200 w. Min Wld—Jan. 28, 1911. No. 20665.

Hydraulic Mining.

Losses in Hydraulic Mining. Charles S. Haley. The difficulty of saving flaky gold, with suggestions. 1500 w. Min & Sci Pr—Jan. 21, 1911. No. 20629.

Manchuria.

Northern Manchuria. C. W. Purington. Map and general information concerning the country, its industries, gold deposits, etc. Ills. 3500 w. Mining Mag—Jan., 1911. No. 20596 B.

Mexico.

The Hostotipaquillo District, Jalisco, Mexico. Austin C. Brady. An account of the transmission of electric power to this district and its use in the mines. Ills. 1600 w. Min Wld—Jan. 7, 1911. No. 20068.

Deep Mining in the Guanajuato District, Mexico. Frank H. Probert. Illustrated description of the Nueva Luz shaft 2031 ft. deep. 1800 w. Eng & Min Jour—Dec. 31, 1910. No. 19865.

Nevada.

The Tonopah District in 1910. Herbert Haas. Review of the year, reporting an increase in production of the precious metals. 1500 w. Eng & Min Jour—Jan. 14, 1911. No. 20188.

Development of the Goldfield Mines. Claude T. Rice. Describes the present condition of the mines, giving information of the ore, methods of working, etc. 4000 w. Eng & Min Jour—Jan. 14, 1911. No. 20186.

Geology of the Jarbidge Mining District. Nelson W. Sweetser. Information concerning the geology and mineralization of this Nevada district. 1000 w. Min & Sci Pr—Dec. 31, 1910. No. 19996.

Ontario.

Montreal River Output and Prospects. Alex. Gray. A report of the Montreal River prospects and their development. 1200 w. Min Wld—Jan. 14, 1911. No. 20209.

The New Goldfields of Porcupine, Ontario. Reginald E. Hore. Illustrated account of the general character of this gold field and information related. 1200 w. Eng & Min Jour—Dec. 31, 1910. No. 19861.

Review of 1910.

The World's Gold and Silver Production in 1910. Statistical review. 3500 w. Min & Sci Pr—Jan. 7, 1911. No. 20154.

Gold, Silver and Platinum in 1910. Frederick Hobart. Statistics on the production and movement of these metals. 3500 w. Eng & Min Jour—Jan. 7, 1911. No. 20032.

Silver Prices.

The Course of Silver in 1910. S. Montagu & Co. Reviews the course of prices as dictated by India and China. 3500 w. Eng & Min Jour—Jan. 28, 1911. No. 20643.

Texas.

Shafter Silver District, Presidio County, Texas. William B. Phillips. Describes the geological features, mineral deposits, and milling methods. Ills. 2200 w. Eng & Min Jour—Dec. 31, 1911. No. 19862.

Transvaal.

Mining in the Transvaal in 1910. Hugh F. Marriott. A review of production, metallurgical practice, etc. Also review of Rhodesia. 4500 w. Eng & Min Jour—Jan. 7, 1911. No. 20046.

IRON AND STEEL.

Bessemer Process.

The Constitution of the Slag Formed in the Basic Bessemer Process (Ueber die Konstitution der Thomasschlacke). Hermann Blome. Reports results of an investigation at the Berlin Technical High School. Ills. 2200 w. Stahl u Eisen—Dec. 21, 1910. No. 20448 D.

Blast-Furnace Practice.

Changes in Iron and Steel Making, Bradley Stoughton. Reviews improvements in blast furnace practice and steel processes. 2000 w. Eng & Min Jour—Jan. 7, 1911. No. 20037.

Blast Furnaces.

The Country's New Blast Furnace Construction. B. E. V. Luty. Annual review, showing 13 new stacks completed in 1910—and increase in commercial capacity of about 33,000,000 tons. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19946 D.

New Iron and Steel Works Construction. A summary of work completed in 1910, or now under way, reporting 18 blast furnaces building or planned. No new steel capacity projected beyond that announced a year ago. 7500 w. Ir Age—Jan. 5, 1911. No. 19909 D.

Brazil.

Important Development in Brazilian Iron Ores. An account of the large iron-ore deposits, secured by an English company, and the arrangements for their de-

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velopment. Also editorial. Maps. 2700 w. Ir & Coal Trds Rev—Jan. 13, 1911. No. 20522 A.

Electrometallurgy.

The 15-Ton Heroult Furnace at South Chicago. Charles G. Osborne. From a paper read before the Chicago Sec. of the Am. Elec.-Chem. Soc. Illustrates and describes details of the manufacture of electric steel. 2500 w. Ir Age—Jan. 26, 1911. No. 20598.

Electric Smelting of Ore in the United States. J. A. Knesche. Aims to show the economic possibilities in making pig iron in the electric furnaces. Ills. 8500 w. Ir Trd Rev—Jan. 5, 1911. No. 19950 D.

The Direct Reduction of Iron Ore in the Electric Furnace (Notes sur la Réduction directe du Minerai de Fer au Four électrique). G. Arnou. Reviews the process of the Société "La Néo-Métallurgie." Ills. 4300 w. Rev de Métal—Dec., 1910. No. 20410. E + F.

Germany.

Mining Methods in the Minette Mines of the Metz District (Die Abbauverfahren auf den grössern Minettegruben des Kaiserlichen Bergreviers Metz). Herr Lämmert. Describes practice in the more important mines of the district. Ills. 7600 w. Glückauf—Dec. 3, 1910. No. 20452 D.

Metallurgy.

The A B C of Iron and Steel. The first of a series of articles by various authors discussing in semi-technical style, the successive stages of iron and steel manufacture. I. Iron Ore and Mining Operations. John Birkinbine. Ills. Plate. 8000 w. Ir Trd Rev—Jan. 5, 1911. Serial. 1st part. No. 19949 D.

Newfoundland.

The Wabana Mines and Haulage System. Illustrated description of submarine mining of iron ore deposits on the coast of Newfoundland. 1500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20538 N.

Open-Hearth Process.

Open-Hearth Ore Processes in Germany (Die Roheisenerzverfahren in Deutschland). R. Genzmer. Abstract of paper read at the Düsseldorf Congress. A review of all the processes in which ore is added to molten pig in the open-hearth furnace. Ills. 7000 w. Stahl u Eisen—Dec. 21, 1910. No. 20446 D.

Ore Imports.

Record Year for Imports of Foreign Ore. Cas. J. Stark. The iron ore imports to the United States from foreign countries is shown to be the greatest in the history of the industry. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19947 D.

Plate Shears.

Electrically-Driven Plate-Shearing Machine. Illustrations with brief description. 300 w. Engng—Jan. 6, 1911. No. 20262 A.

Review of 1910.

The Iron and Steel Industry in 1910. Frederick Hobart. Statistical review, with articles by other authors giving information concerning the mines. 8500 w. Eng & Min Jour—Jan. 7, 1911. No. 20036.

See also Trade, under IRON AND STEEL.

Segregation.

The Influence of Segregation on the Strength of Steel (Der Einfluss der Seigerung auf die Festigkeit des Flusseisens). F. Wüst and H. L. Felser. Read at the Düsseldorf Congress. Reports chemical and mechanical tests on blocks of Bessemer and open-hearth steel. Ills. 3800 w. Stahl u Eisen—Dec. 21, 1910. No. 20447 D.

Spain.

The Bilbao Iron Deposits and Their Importance as Sources of Ore Supply for England and Germany (Die Eisenerzlagerstätten von Bilbao und ihre Bedeutung für die zukünftige Eisenerzversorgung Grossbritanniens und Deutschlands). Herr John. The first part discusses the geology, composition, and extent of the deposits. Ills. 8000 w. Glückauf—Dec. 17. 1910. No. 20456 D.

Steel Making.

See Blast-Furnace Practice, under IRON AND STEEL.

Steel Works.

The Works of John Cockerill, Seraing, Belgium. Illustrated detailed description of works employing 11,000 workmen, the methods and equipment. 2500 w. Engr, Lond—Dec. 23, 1910. No. 19978 A.

Steel-Works Ladles.

Modern Steel-Works Ladle Cars and Ladle Cranes (Chariots de Coulée et Grues de Coulée modernes pour Aciéries). C. Michenfelder. A detailed review of modern equipment for handling molten metal. Ills. Serial. 1st part. 6000 w. All Indus—Nov., 1910. No. 20423 D.

Trade.

The Iron and Steel Trade Outlook. T. Good. Reviews from a British viewpoint the possibilities involved in American and British competition. 2500 w. Cassier's Mag—Jan., 1911. No. 20309 B.

The Cincinnati Iron Trade in 1910. Charles L. Smith. Reviews the industry and the influences affecting it. 1800 w. Ir Age—Jan. 5, 1911. No. 19916 D.

The Chicago Iron Trade in 1910. R. L. Ardrey. Review of the iron and steel industry with comparison of prices. 2000 w. Ir Age—Jan. 5, 1911. No. 19915 D.

The Philadelphia Iron Trade in 1910. August A. Miller. A review of production and prices of crude and finished material. 2500 w. Ir Age—Jan. 5, 1911. No. 19914 D.

The Pittsburgh Iron Trade in 1910. Robert A. Walker. Review of a very unsatisfactory year. 3000 w. Ir Age—Jan. 5, 1911. No. 19913 D.

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The Sheet and Tin Plate Trades in 1910. B. E. V. Luty. Reviews the production, the market, etc. 1700 w. Ir Age—Jan. 5, 1911. No. 19918 D.

See also same title, under COAL AND COKE.

Tube Mills.

The Republic Iron & Steel Company's New Tube Works. Illustrated detailed description of an important addition to its finishing mills in the Youngstown, Ohio, district. 2000 w. Ir Age—Jan. 5, 1910. No. 19910 D.

LEAD AND ZINC.

Australia.

Zinc Production in Australia. Edward Walker. Information concerning the production and processes, particularly at Broken Hill. Ills. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20146.

Lead Smelting.

The Metallurgy of Lead in 1910. H. O. Hofman. A review of practice showing few improvements during the year with the exception of some devices for hastening and cheapening operations. 3500 w. Eng & Min Jour—Jan. 7, 1911. No. 20041.

See also Smelting, under COPPER.

Nevada.

The Yellowpine Mining District of Nevada. Newman B. Gregory. Report of a zinc-lead-silver district first worked by Mormons. 2500 w. Eng & Min Jour—Dec. 31, 1910. No. 19864.

Zinc Mining at Yellow Pine, Nev. Newman B. Gregory. Brief account of the discovery and development of large deposits of zinc carbonate. Ills. 1800 w. Mines & Min—Jan., 1911. No. 19898 C.

Review of 1910.

Refined Lead and Spelter in United States in 1910. Review of imports, exports, consumption and prices. 2000 w. Min Wld—Jan. 21, 1911. No. 20375 C.

The Production of Lead in 1910. Statistics, with an article on the "Southeast Missouri Lead District," by H. A. Wheeler. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20034.

The Zinc Industry in 1910. Statistics of production and prices, with articles on the important districts, signed by well-known engineers. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20035.

MINOR MINERALS.

Asbestos.

Some Notes on the Origin of Asbestos. A. E. Barlow. Remarks on the origin and formation. Short discussion. 1800 w. Qr Bul of Can Min Inst., No. 12—Oct., 1910. No. 20532 N.

Asbestos, Its Production and Use. H. R. Edgecomb. Information concerning the origin, varieties, characteristics, distribution, production, mining, preparation, uses, etc. Ills. 3000 w. Elec Jour—Jan., 1911. No. 20324.

Cement.

Notes on Portland Cement. D. B. Butler. The present article deals with its manufacture. 3000 w. Aust Min Stand—Dec. 14, 1911. Serial. 1st part. No. 20277 B.

Chromium.

A Study of Electrolytic Chromium (Etude sur le Chrome électrolytique). Jean Voisin. Reviews previous researches, and reports an investigation of the electrolytic production and properties of Chromium. Ills. 5500 w. Rev de Métal—Dec., 1910. No. 20406. E + F.

Cobalt.

The Use of Cobalt Oxide for Making Pigments. J. J. McEachern. Gives results of experiments made in an endeavor to test the possibilities of extending the usefulness of cobalt oxide. 4500 w. Qr. Bul of Can Min Inst, No. 12—Oct., 1910. No. 20536 N.

Nickel.

The Nickel Industry of Canada in 1910. Alex. Gray. Reviews a prosperous year. 3000 w. Min Wld—Jan. 21, 1911. No. 20377 C.

Ocher.

Georgia Ocher Mining and Treatment. W. S. McCallie. Information concerning the deposits and methods of mining and preparing for market. Ills. 700 w. Min Wld—Dec. 31, 1910. No. 19855.

Oil.

Petroleum in the United States. Articles by M. L. Requa, E. Haworth, H. C. George, and R. S. Blatchley, giving information concerning the different oil-fields. 5000 w. Eng & Min Jour—Jan. 7, 1911. No. 20047.

The Petroleum Industry in California. Ralph Arnold. A general statement with a review by districts. 2500 w. Min & Sci Pr—Jan. 7, 1911. Serial. 1st part. No. 20159.

Oil Resources of California. M. L. Requa. Map showing the various oilfields developed, with information concerning them. 3500 w. Mining Mag—Jan., 1911. No. 20595 B.

Illinois Oilfields in 1910. Raymond S. Blatchley. Reports production by months, and reviews conditions in the different countries. 1600 w. Min & Sci Pr—Jan. 7, 1911. No. 20160.

The South's Oil Contribution. Dr. David T. Day. Information concerning the production in the Southern States. Also brief review of production in 1910; and a note on natural oil filtration. 4500 w. Mfrs' Rec—Jan. 19, 1911. No. 20290.

Maikop: The Position To-Day. E. de Hautpick. Information concerning this petroleum region. 900 w. Min Jour—Jan. 14, 1911. No. 20504 A.

Phosphate.

Tennessee Phosphate in 1910. John Ruhm, Jr. A review of the industry for

the past year, the changes and tendencies. 1400 w. Eng & Min Jour—Jan. 14, 1911. No. 20187.

Platinum.

See Review of 1910, under GOLD AND SILVER.

Precious Stones.

Gem Mining in California a Profitable Industry. A. H. Martin. Information concerning the tourmaline and turquois deposits. 1500 w. Min Wld—Dec. 31, 1910. No. 19856.

Sodium.

Deposits of Sodium Salts in Wyoming. Alfred R. Schultz. Abstracted from Mineral Resources of the U. S. Map and brief description. 1200 w. Min Wld—Dec. 31, 1910. No. 19858.

Tin.

The Northern Dundas Tin District. J. M. Bell. Information concerning those tinfields of Tasmania. 1500 w. Mining Mag—Jan., 1911. No. 20507 B.

Tin Quartz Mining and Smelting in Texas. Charles A. Dinsmore. An illustrated account of a deposit near El Paso, Tex., and its recent development. 2000 w. Min Wld—Dec. 31, 1910. No. 19857.

MINING.

Accidents.

Mining Accidents. Day Allen Willey. Experimental investigations of safety appliances are illustrated and described. 2000 w. Cassier's Mag—Jan., 1911. No. 20306 B.

Boring.

A B C of Empire Drilling. J. P. Hutchins and N. C. Stines. An illustrated article giving details essential to the efficient manipulation of a particular type of drill as used in sampling alluvial ground, with other information. 3500 w. Min & Sci Pr—Jan. 7, 1911. Serial. 1st part. No. 20152.

Costs.

Graphic Calculations of Development Work Costs. Claude T. Rice. Gives contract diagrams, with explanation of their use. 600 w. Eng & Min Jour—Jan. 21, 1911. Serial. 1st part. No. 20360.

Development.

Preliminary Development Work. Alan M. Bateman. Gives facts derived from personal experience. Ills. 2500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20537 N.

See also Costs, under MINING.

Drainage.

See Mine Drainage, under COAL AND COKE.

Drills.

A Comparison of Electric and Gasoline Driven Blast-Hole Drills. B. G. Cope. Discusses the kind of power most suitable for operating blast-hole drills of the well driller type in quarry work. 1200 w. Eng News—Dec. 29, 1910. No. 19798.

Automatic Drill Advancing Devices (Selbstätige Vorschubvorrichtungen für Bohrhämmer). Herr Cabolet. Describes the devices incorporated in a number of European drills. Ills. 8500 w. Glückauf—Dec. 10, 1910. No. 20454 D.

Explosives.

The Works of the British Explosives Syndicate, Limited, Pitsea, Essex. Illustrated, detailed description of the methods of manufacture of the explosives made. 5000 w. Col Guard—Jan. 13. 1911. No. 20509 A.

The Use of Chlorates in Commercial Explosives. A. L. Jones. An interesting review of past and present experience with explosives using chlorates. 2000 w. Eng News—Jan. 5, 1911. No. 19934.

Notes on Explosives (Ueber Sprengmittel). W. Will. The first part reviews the history of explosives. Serial. 1st part. 4200 w. Zeitschr d Oest Ing u Arch Ver—Dec 16, 1910. No. 20481 D.

Graphic Records.

A Graphical Note-Book. F. W. Gray. Explains a graphic method of recording data in connection with mining work. 2000 w. Mines & Min—Jan., 1911. No. 19896 C.

Haulage.

Installation, Operation, and Supervision of Mine Railways (Anlage, Inbetriebsetzung und Beaufsichtigung der dem Bergwerksbetriebe dienenden Bahnen). The text of regulations recently issued by the Mine Inspector, Breslau, Germany. 7000 w. Glückauf—Dec. 3, 1910. No. 20453 D.

See also Newfoundland, under IRON AND STEEL.

Hoisting Cages.

Improvements in Hoisting Cages. James J. Smith. Gives details of simple arrangements which will lessen accidents. 3500 w. Eng & Min Jour—Jan. 21, 1911. No. 20357.

Laws.

Mining Laws of Burma. C. Dawes Clark. Deals principally with the rules governing metal mining, and how they work in practice. 2500 w. Min & Sci Pr—Jan. 14, 1911. No. 20292.

Mine Cars.

Tub Couplings Used in German Collieries. O. Schulz, in *Glückauf*. Illustrates and describes improved types introduced. 1500 w. Col Guard—Dec. 23, 1910. No. 19969 A.

Mine Locomotives.

Two-Stage Air Locomotives. Discusses the increased economy of two-stage compared with single-stage compressed air locomotives. Ills. 5500 w. Mines & Min—Jan., 1911. No. 19899 C.

Photography.

Photography for Mining Engineers and Geologists. H. Mortimer Lamb. Suggestions as to practical methods of work-

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ing, when in the field, to secure satisfactory results. 2500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20531 N.

Prospecting.

See same title, under COAL AND COKE.

Pumping.

The Old Dominion Pumping System. R. S. Herrick. Illustrates and describes the equipment of pumps, arrangement of sump, etc., in the new plant. 2000 w. Mines & Min—Jan., 1911. No. 19895 C.

Shaft Sinking.

Recent Developments in the Freezing Process (Das Gefrierverfahren und seine neueste Entwicklung). Herr Zaeringer. Describes the practice of Gebhardt & König in Austria. Ills. Serial. 1st part. 2300 w. Oest Zeitschr f Berg u Hüttenwesen—Dec. 17, 1910. No. 20451 D.

Shaft Stations.

Proposed Layout for a Shaft Bottom. Plan and description. 500 w. Eng & Min Jour—Jan. 21, 1911. No. 20362.

Stoping.

The Shrinkage Method of Stoping at the Ferreira Gold Mine. G. Heldick Smith. Considers "shrinkage" and "back filling" methods of overhand stoping as practiced in various parts of the world, describing the method as applied at the mines named, and discussing the advantages, disadvantages, etc. Ills. 5000 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1910. No. 20240 E.

Surveying.

On Methods of Making Large Scale Contour Surface Plans of Claims or Mining Properties. W. H. Boyd. Suggests methods that can be employed at a comparatively small cost with sufficiently accurate results. Ills. 3000 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20530 N.

ORE DRESSING AND CONCENTRATION.

Classifiers.

Development of Hindered Settling Apparatus. Robert H. Richards. Reviews the steps taken in the development, the facts obtained, and some of the conclusions as to the effect of it in improving concentrating methods and machinery. Ills. 10500 w. Qr Bul of Can Min Inst, No. 12—Oct., 1910. No. 20528 N.

Drying.

New Methods and Apparatus for Coal Drying (Neuere Verfahren und Einrichtungen auf dem Gebiete der Kohletrocknung). Herr Jordan. Describes types of revolving and stationary drum dryers. Ills. 3000 w. Glückauf—Dec. 10, 1910. No. 20455 D.

Filters.

New Slime Filter at El Oro, Mex. Edwin Burt. Illustrated description of a horilontal tubular filter operating under pressure from gravity. 1600 w. Eng & Min Jour—Jan. 21, 1911. No. 20358.

Gold Milling.

Progress in Treatment of Gold and Silver Ores During 1910. Alfred James. A review of progress in the various gold mining countries, the new methods introduced, and related subjects of interest. Ills. 4000 w. Min & Sci Pr—Jan. 7, 1911. No. 20155.

Stamp Milling in 1910. Louis D. Huntoon. Reviews practice in the United States and South Africa. 2000 w. Eng & Min Jour—Jan. 7, 1911. No. 20040.

Iron Ores.

Washing the Sandy Ores of the Western Mesabi. E K. Soper. Illustrated description of a concentration plant which makes possible the utilization of the inferior ores of the Minnesota ranges. 3000 w. Ir Trd Rev—Jan. 19, 1911. No. 20291.

Review of 1910.

Progress in Ore Dressing in United States and Mexico During 1910. H. A. Guess. Reviews progress in water concentration, cyaniding, etc. 2200 w. Met & Chem Engng—Jan., 1911. No. 20129 C.

Silver Milling.

See Gold Milling, under ORE DRESSING AND CONCENTRATION.

Slimes Treatment.

Mechanical and Air Agitation for Slime Treatment. A. W. Warwick. Comments on the defects of the Pachuca tank. 2000 w. Min Wld—Jan., 1911. No. 20664.

MISCELLANY.

Alaska.

Mineral Resources Southern Kenai Peninsula. U. S. Grant and D. F. Higgins. Abstract from Bul. 442, U. S. Geol. Surv. Maps and information concerning deposits of iron, gold, silver, antimony, and coal. 4500 w. Min Wld—Jan. 14, 1911. No. 20210.

British Columbia.

British Columbia. E. Jacobs. A review of the mining industry. 3000 w. Can Min Jour—Jan. 1, 1911. No. 19893.

Metallury in British Columbia in 1910. E. Jacobs. Reviews progress in the smelting of lead and copper ores, and related matters. 5500 w. Met & Chem Engng—Jan., 1911. No. 20127 C.

The Mineral Resources of a Part of the Yale District, B. C.—A Descriptive Summary. Charles Camsell. Considers the general and economic geology of this region. 5500 w. Qr Bul of Can Min Inst—Oct., 1910. No. 20533 N.

Canada.

The Production of Cement, Lime, Clay Products, Stone, and Other Structural Materials in Canada During the Calendar Year 1909. John McLeish. Advance chapter of the Annual Report on the mineral production. 11000 w. Can Dept of Mines, No. 85. No. 20313 N.

I. Ontario Mineral Production in 1910. Thomas W. Gibson. II. Mining in Brit-

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ish Columbia in 1910. E. Jacobs. Reviews of the metals in order. 2800 w. Eng. & Min Jour—Jan. 7, 1911. No. 20045.

China.

The Far East. Thomas T. Read. A review of mining conditions and the effect of international politics on the industry. 2500 w. Min & Sci Pr—Jan. 7, 1911. No. 20158.

Colorado.

The Status of Meallurgy in Colorado in 1910. A review of progress in smelting, chlorination, cyaniding, ore dressing, etc. 3500 w. Met & Chem Engng—Jan., 1911. 20126 C.

Colorado Mineral Production. Theo. F. Van Wagenen. Gives an analysis of the mining situation, discussing the decline in output, and the causes. 1500 w. Min & Sci Pr—Jan. 7, 1911. No. 20148.

Utilization of Colorado Minerals. Franklin Ginterman. Excerpts from a paper on "The Use, Non-use and Waste of the Mineral Resources of Colorado." Read before the Colo. Sci. Soc. 4000 w. Eng & Min Jour—Jan. 21, 1911. No. 20359.

Costa Rica.

Costa Rica Mineral Resources. Lee Fraser. Reviews the history and gives information of conditions and of the known occurrences of minerals. Ills. 2000 w. Min & Sci Pr—Jan. 21, 1911. No. 20627.

Japan.

Mineral Resources of the Japanese Empire. Dr. A. Selwyn-Brown. An illustrated review of coal, iron, petroleum and minor metals. 4000 w. Engineering Magazine—Jan., 1911. No. 19746 B.

London Market.

London Mining Market. T. A. Rickard. Reviews the year 1910, giving information concerning various mining products and the mining conditions in different parts of the world. 3800 w. Min & Sci Pr—Jan. 7, 1911. No. 20145.

Metal Markets.

Metal Reviews. Brief reviews by different authors of the market for copper, spelter and zinc ore, lead and silver during 1910. 2000 w. Min & Sci Pr—Jan. 7, 1911. No. 20144.

Mexico.

Mining in Mexico in 1910. Kirby Thomas. A review of the mining industry for the year, each district being reported by writer of authority. 10800 w. Eng & Min Jour—Jan. 7, 1911. No. 20043.

General Conditions in Mexico. Theo. F. Van Wagenen. Deals with racial characteristics, the geographical, topographical and climatic features, agricultural and mineral products, and the effect of other civilizations. Ills. 4000 w. Mining Mag—Dec., 1910. No. 19737 B.

South of the Rio Grande River, Mexico. Walter M. Brodie. Illustrated description of the country and its mineral wealth. Map. 2200 w. Min Wld—Dec. 10, 1910. No. 19282.

Mining Frauds.

Protecting Investors by Exposing Mining Frauds. C. S. Thomas, Jr. Discusses the need of legislation and publicity to supplement the work of postal authorities. 4000 w. Eng & Min Jour—Dec. 10, 1910. No. 19260.

Nevada.

Metallurgical Progress in Utah and Nevada During 1910. Robert H. Bradford. A general review. 6000 w. Met & Chem Engng—Jan., 1911. No. 20134 C.

Nicaragua.

Mining in Nicaragua. T. Lane Carter. Sketch map showing the location of mining districts, brief review of their history, mining laws, transportation facilities, health conditions, etc., showing the difficulties and advantages. Ills. 12500 w. Bul Am Inst of Min Engrs—Dec., 1910. No. 19715 F.

Ontario.

Ontario in 1910. T. W. Gibson. A review of the mining industry. 2000 w. Can Min Jour—Jan. 1, 1911. No. 19892.

Ore Deposits.

Origin of Gold "Pockets" in Northern California. Oscar H. Hershey. A study of the pocket deposits with the writer's past and present views in regard to their origin. 1700 w. Min & Sci Pr—Dec. 3, 1910. No. 19254.

Secondary Enrichment in the Copper Deposits of Huelva, Spain. A. Moncrieff Finlayson. Gives results of investigations made in the summer of 1909, by microscopic methods. 5000 w. Inst of Min & Met. Bul. No. 74—Nov. 9, 1910. No. 19763 N.

Discussion on "Secondary Enrichment in the Copper Deposits of Huelva, Spain." Critical discussion of conclusions drawn by A. Moncrieff Finlayson in his paper on this subject. 6500 w. Inst of Min & Met, Bul. No. 75—Dec. 14, 1910. No. 19768 N.

Anthracite in a Fissure Lode. Lionel C. Ball. Read before the Roy. Soc. of Queensland. Brief record of an occurrence of coal as gangue in a lead-zinc fissure lode. 500 w. Queens Gov Min Jour—Dec. 15, 1910. No. 20242 B.

The Laws of Intrusion. Blamey Stevens. Aims to show how igneous intrusion is governed by definite mathematical laws, and that the main factor is the system of stress to which the rocks are subject. Ills. 6500 w. Bul Am Inst of Min Engrs—Jan., 1911. No. 20580 F.

The Genesis of Asiatic Mineral Deposits (La Métallogénie du Continent Asiatique). L. De Launay. Develops the author's theory of metallogenetic provinces as applied to Asia. 5000 w. Rev Gen d Sci—Dec. 15, 1910. No. 20416 D.

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Quebec.

The Mining Industry in the Province of Quebec During 1910. Theo. Denis. A review of the past year. 2000 w. Can Min Jour—Jan. 1, 1911. No. 19891.

Review of 1910.

The Non-Ferrous Metal Markets in 1910. J. Chalmers Warwick. Review of the copper, tin, lead and spelter markets, with estimates of production and price fluctuations. 2500 w. Ir Trd Rev—Jan. 5, 1911. No. 19952 D.

South America.

Mining in South America in 1910. A general review, and also a review of Chile, by H. K. Masters. 4000 w. Eng & Min Jour—Jan. 7, 1911. No. 20044.

Sweden.

Swedish Mines and Mining. Horace V. Winchell. Interesting review of the important mining districts. 3500 w. Min & Sci Pr—Jan. 7, 1911. No. 20151.

United States.

Mining in the United States. A review by states of the mining industry during 1910, by leaders in their various fields. Map. 17000 w. Eng & Min Jour—Jan. 7, 1911. No. 20042.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Collisions.

A Disastrous Collision on the Midland Railway of England. H. Raynar Wilson. An explanation of the cause of the accident occurring on Dec. 24, 1910. 1200 w. Eng News—Jan. 26, 1911. No. 20619.

Signaling.

Third Annual Report of the Block-Signal and Train-Control Board to the Interstate Commerce Commission. (Slightly condensed.) 9000 w. Eng News—Jan. 19, 1911. No. 20289.

Third Annual Report of Block-Signal and Train-Control Board. Brief review of the work of the Board, and of the devices examined. 4500 w. Ry Age Gaz—Jan. 20, 1911. Serial. 1st part. No. 20350.

The "Run-Through Signal." Dr. Hans A. Martens. A critical discussion of this signal as used. 3800 w. Bul Int Ry Cong—Jan., 1911. No. 20594 G.

The Route Lever in Mechanical and Power Switch Frames. Mr. Pfeil. Also note by Mr. Kraft, and reply. 2700 w. Bul Int Ry Cong—Jan., 1911. No. 20593 G.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Presidential Address. George Westinghouse. An account of the conception and development of the air-brake. Ills. 6000 w. Jour Am Soc of Mech Engrs—Jan., 1911. No. 20570 F.

No. 6 Distributing Valve Test Rack. Illustrated description of a test rack for use in connection with the cleaning and repairing of distributing valves. 2500 w. Ry & Loc Engng—Jan., 1911. No. 20017 C.

Car Cleaning.

Cleaning Passenger Equipment at Terminals. J. H. Pitard. Suggestions for the proper care of equipment, especially the cleaning compounds used. 1200 w. Ry Age Gaz—Jan. 6, 1911. No. 20028.

Electrification.

The Electrification Problem on Trunk Line Railways. A. D. Williams. Considers the problems that must be solved before any general revolution in methods of operation can occur. 1800 w. Engineering Magazine—Feb., 1911. No. 20683 B.

The Electrical Equipment of the Detroit River Tunnel. Remarks on improvement of railroad facilities at Detroit, Mich., with illustrated description of the electrical scheme. 3000 w. Elec Ry Jour—Jan. 14, 1911. Serial. 1st part. No. 20161.

Locomotive Boilers.

Improved Boiler Washing Apparatus. Illustrates and describes the National Boiler Washing equipment. 1200 w. Ry & Loc Engng—Jan., 1911. No. 20020 C.

Locomotive Efficiency.

The Efficiency of the Steam Locomotive (Der Wirkungsgrad der Dampflokomotive). Dr. Sanzin. Reports tests made by the author under various conditions. 8100 w. Zeitschr d Oest Ing u Arch Ver—Dec. 2, 1910. No. 20479 D.

Locomotive Maintenance.

Standard Locomotive Maintenance Practices. Gives returns from several railways indicating the importance of standardization in defining limits of wear. Also editorial. 2700 w. Am Engr & R R Jour—Jan., 1911. No. 19930 C.

Locomotive Operation.

Notes on the Economics of Locomotive Operation. Arthur J. Wood. Considers lines of progress leading to better economy and higher efficiency. 4000 w. Stevens' Ind—Jan., 1911. No. 20315 D.

Locomotive Performance.

Performance of Four-Cylinder Balanced Simple Locomotive on the C., R. I. & P. Ry. An account of the behavior of engines in service more than a year, with data concerning special tests. 1500 w. Ry & Engng Rev—Jan. 21, 1911. No. 20384.

Locomotives.

Locomotives. Reviews the British Locomotives of 1910. Ills. 2500 w. Engr, Lond—Jan. 6, 1911. No. 20271 A.

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High Speed Locomotives. A review of the development in various countries for runs scheduled at over sixty miles an hour. 6500 w. Am Engr & R R Jour—Jan., 1911. No. 19932 C.

4-8-0 Type Locomotives for the Norfolk & Western Railway. Powerful locomotives, known as class M-2, are illustrated and described. 1200 w. Am. Engr & R R Jour—Jan., 1911. No. 19929 C.

Four-Cylinder Balanced Simple Locomotives, Chicago, Rock Island and Pacific. Abstract of Bul. No. 1007. Am. Loc. Co., N. Y. Describes these engines, reporting service tests, and illustrates the design and details. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20029.

Mikado Locomotive for Burning Lignite; Oregon Railroad and Navigation Company. Illustrated description of an engine specially built to burn lignite, with report of tests. 1000 w. Ry Age Gaz—Jan. 27, 1911. No. 20637.

4-4-0 Engine for the Western Railroad of Havana. Illustrated description of an 8-wheel passenger locomotive. 800 w. Ry & Loc Engng—Jan., 1911. No. 20018 C.

Locomotive Spark Arresters.

Notes of Experiments Upon Locomotive Spark-Arresters. Thomas Thompson. Read before the Students' Soc. of the Inst. of Engrs. & Shipbldrs. in Scotland. An illustrated report of experiments made by the Caledonian Ry Co. in Jan., 1909. 2500 w. Mech Engr—Dec. 30, 1910. No. 20085 A.

Locomotive Superheating.

The Effect of High Temperatures on Locomotive Cylinders and Valves. Editorial discussion of effects of superheating, giving testimony from a number of sources. 1500 w. Ry Age Gaz—Jan. 20, 1911. No. 20349.

Feed-Water Heating and Superheating on the Egyptian State Railways. Drawings and brief account of the Trevithick combined system of feed-water heating and superheating. 700 w. Engr, Lond—Jan. 13, 1911. No. 20520 A.

Locomotive Tests.

Tests of "E2a" Atlantic Type, Simple Locomotive. Gives results of a series of tests made at the testing plant at Altoona, Penna., describing the locomotive, and giving illustrations, diagrams, tables, etc. 8500 w. Penn R R Co, Bul No. 5. No. 20310 N.

Locomotive Valve Gears.

The Pilliod Locomotive Valve Gear. Illustrated detailed description of an ingenious mechanism for imparting valve motion through crosshead connection, without either eccentric or return crank. 1000 w. Am Engr & R R Jour—Jan., 1911. No. 19931 C.

Passenger Cars.

Luxurious Private Car for South America. Illustrations and brief description of a car for the President of the Argentine Republic. 500 w. Sci Am—Jan. 7, 1911. No. 19942.

Composite Steel Passenger Equipment. Illustrates and describes an interesting design wherein the framing and exterior sheathing are of steel and the interior finishing from the sash rest up is of wood. 2500 w. Am Engr & R R Jour—Jan., 1911. No. 19928 C.

Shops.

Railroad Repair Shop Efficiency. Max H. C. Brombacher. Tabulated information requested by the Interstate Commerce Commission, with analysis of the contents of the tabulation, showing great variations in the shop costs of different companies. 3000 w. Ir Age—Jan. 5, 1911. No. 19908 D.

Increasing Shop Output. Gives prize papers on this subject by H. L. Burrhus, C. E. Stone, Charles Maier, and J. F. Perritt. 4000 w. Ry Age Gaz—Jan. 6. 1911. No. 20026.

Care and Selection of Shop Equipment. Articles by W. P. Spade, John V. Le Compte, W. H. Snyder, John M. Hamm, William G. Reyer, and others. 5500 w. Ry Age Gaz—Jan. 6, 1911. No. 20030.

Micrometer Boring Bar for Car Wheels. R. R. Wan. Illustrates and describes a boring bar with improved micrometer attachment, explaining its advantages. 1500 w. Am Mech—Jan. 26, 1911. No. 20606.

Car Repair Kinks. Illustrated prize papers by W. H. Snyder and C. C. Leech, F. Rattek and A. G. Pancost. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20024.

The Central of Georgia Railway Boiler Shop. Sections and details of framing of shop at Macon, Ga. 1200 w. Eng Rec—Jan. 21, 1911. No. 20341.

The Locomotive Repair Shops of the Burlington at Havelock, Neb. Illustrated detailed description of reconstructed and additional shops and new power plant. Plate. 2500 w. Ry Age Gaz—Jan. 6, 1911. No. 20027.

Shops of the Chicago, Burlington & Quincy R. R. at Havelock, Neb. Illustrated detailed description of the extensive additions to the equipment at the plant near Lincoln, Neb. 2500 w. Ry & Engng Rev—Dec. 31, 1910. No. 19876.

Supply Department.

The Supply Department. H. C. Pearce. A study of the losses due to lack of organization and intelligent watchfulness. 3000 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20021.

Train Resistance.

Freight Train Resistance—Its Relation to Car Weight. Edward C. Schmidt. A report of tests, methods and means of conducting them, with discussion of results. 20000 w. Bul Univ of Ill—May 30, 1910. No. 20669 N.

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NEW PROJECTS.

Africa.

The Benguella Railway. Map and information concerning a new line in Portuguese Angola, South-West Africa. 500 w. Engr, Lond—Dec. 23, 1910. No. 19981 A.

D., L. & W. R. R.

New Cut-Off Line, D., L. & W. R. R. Illustrates and describes the construction of the line between Slateford, Pa., and Hopatcong, N. J. 1600 w. Ry & Engng Rev—Jan. 28, 1911. No. 20662.

Switzerland.

The Furka Railway (Les Chemins de Fer de la Furka). Brief description of the Brigue-Gletsch-Disentis line about to be constructed. Ills. 2000 w. Bul Tech d l Suisse Romande—Dec. 25, 1910. No. 20422 D.

Western Maryland.

The Western Maryland Extension to Connellsville, Penn. Map and illustrated description of the new line from Cumberland, Md., to Connellsville, a distance of 87 miles. 3000 w. Eng Rec—Dec. 31, 1910. No. 19873.

The Cumberland-Connellsville Extension of the Western Maryland Ry. Map and description of 87 miles of construction work. 1000 w. Eng News—Jan. 26. 1911. No. 20621.

PERMANENT WAY AND BUILDINGS.

Construction.

See Excavation, under CIVIL ENGINEERING, CONSTRUCTION.

Crossings.

Notes on the Design and Construction of Railroad Crossings. Illustrations, with discussion of types of crossings and details of construction. 3300 w. Engng Con—Jan. 25, 1911. No. 20614.

Railway Grade Crossing Elimination in Cleveland. Robert Hoffmann. Explains the general conditions, reviewing the history of grade separation, and illustrating and describing construction work. Discussion. 8500 w. Jour Cleveland Engng Soc—Dec., 1910. No. 20328 D.

Curves.

New Methods of Laying Out Curves (Méthodes nouvelles pour l'Etude des Tracés de Voies). P. Le Fort. An exhaustive discussion of methods developed by the author. Ills. Serial. 1st part. 22000 w. Rev Gen d Chemins d Fer—Dec., 1910. No. 20411 G.

Explosions.

The Disastrous Explosion at the Grand Central Terminal. Illustrated description of the results of the explosion. 800 w. Sci Am—Dec. 31, 1910. No. 19787.

Narrow Gauge.

A Remarkable American Forest Railway. A. Reiche. Illustrates and describes a profitable narrow-gauge industrial road in Michoacan, Mexico. 1200 w. Sci Am Sup—Jan. 28, 1911. No. 20639.

Rails.

Rail Trimming Mill and Material Yard, C., M. & St. P. Ry. Illustrates and describes a mill for trimming or "cropping" the ends of worn rails, and a yard for stock piles of trimmed and rerolled rails, joints, splices and tie plates, located at Savanna, Ill. 2500 w. Ry & Engng Rev—Jan. 14, 1911. No. 20211.

Snow Sheds.

Snow Sheds on the Great Northern. Illustrates and describes a reinforced-concrete shed at Wellington, Wash. 1000 w. Ry Age Gaz—Jan. 13, 1911. No. 20165.

Terminals.

Railway Passenger and Freight Terminals in Large Cities. Frederic A. Delano. From a paper in the Chicago "Tribune" of Dec. 14. Suggestions for solving the problem in Chicago, with a general analysis of railway terminal facilities. 1500 w. Eng News—Jan. 5, 1911. No. 19941.

Union Terminals of Canadian Northern Railway and Grand Trunk Pacific Railway at Winnipeg, Manitoba. C. D. Archibald. Describes the passenger and freight terminals. Ills. 2500 w. Can Engr—Jan. 19, 1911. No. 20381.

Tie Plates.

New Tie Plates of the Pittsburgh & Lake Erie R. R. Illustrated description of two forms adopted, one for ordinary track, the other on bridges. 1200 w. Eng News—Jan. 26, 1911. No. 20622.

Ties.

Railway Cross-Tie Records. From a paper by F. J. Angier. On the unreliability of the records with suggestions for keeping a service record. 3500 w. Eng Rec—Jan. 28, 1911. No. 20654.

Track Laying.

Cost of Track Laying. H. C. Landon. A report of cost and progress of track laying by the old methods. 700 w. Ry Age Gaz—Jan. 13, 1911. No. 20163.

Train Sheds.

Bush Train Shed at Baltimore. Illustrated description of a Bush train shed installed over depressed tracks. 700 w. Ry Age Gaz—Jan. 13, 1911. No. 20162.

Yards.

The Design and Operation of a Modern Classification Yard. W. A. MacCart. An outline of hump methods used in a yard. Ills. Also discussion. 4000 w. Pro Engrs' Club of Phila—Jan., 1911. No. 20579 D.

TRAFFIC.

Damage Liability.

The Initial Carrier's Liability. Abstract of opinion of the U. S. Supreme Court in holding the initial carrier liable for damages occurring off its own lines. 3000 w. Ry Age Gaz—Jan. 13 1911. No. 20164.

Freight Rates.

The Rate Advance Investigation. A Composite Brief. Willard A. Smith. Pre-

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sents the points on which the writer believes the case must be decided. 4000 w. Ry & Engng Rev—Jan. 28, 1911. No. 20663.

Studies in Railway Economics. W. M. Acworth. A discussion of the principles governing railway rate making. 2000 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20023.

MISCELLANY.

Canada.

Prosperity of Canadian Railways. J. L. Payne. An interesting account of growth and general prosperity during 1910. 3000 w. Ry Age Gaz—Jan. 6, 1911. No. 20022.

Capitalization.

Two Studies of Railway Capitalization. Editorial discussion of certain points brought out in articles by Frank Trumbull, and by W. H. Williams. 2000 w. Ry Age Gaz—Feb. 3, 1911. No. 20798.

Economics.

The Re-working of Old Material. Jas. S. Sheafe. An illustrated account of the economies and saving effected by the methods of the Illinois Central Railroad. Discussion. 11000 w. Pro W Ry Club—Dec. 20, 1910. No. 20546 C.

International Congress.

The XXVth Anniversary of the Foundation of the International Railway Congress Association. L. Weissenbruch. Reviews the history from 1885 to 1910. 66700 w. Bul Int Ry Cong—Jan., 1911. No. 20592 G.

Official Information Issued by the Permanent Commission of the International Railway Congress Association. Summary of proceedings of the eighth session, at Berne, 1910. 73000 w. Bul Int Ry Cong—Dec., 1910. No. 20547 G.

Report of the Interstate Commerce Commission. Abstract of the report on the work of the commission. 4000 w. Ry Age Gaz—Dec. 30, 1910. Serial. 1st part. No. 19847.

Proceedings of the Eighth Session of the International Railway Congress, Berne. July, 1910 (Compte rendu sommaire des Séances de la 8e Session du Congrès International des Chemins de Fer). Summarizes the action of the Congress on the various questions submitted. 14500 w. Rev Gen d Chemins d Fer—Dec., 1910. No. 20412 G.

Italy.

The Railways of Liguria and Piedmont (La Rete ferroviaria Ligure-Piemontese). Describes transportation facilities in this part of Italy. Serial. 1st part. 2000 w. Ing Ferro—Dec. 1, 1910. No. 20443 D.

Malay States.

The Federated Malay States Railways. Information concerning the proposed extensions of the system and the financial conditions. Map and Ills. 1200 w. Far East Rev—Dec., 1910. No. 20888 N.

Management.

The Mistakes of Efficiency Men. This first article of a series discusses the extravagant statements and claims made in regard to railway management—Also editorial. 3200 w. Ry Age Gaz—Jan. 6, 1911. Serial. 1st part. No. 20025.

United States.

Review of 1910 Annual Reports. Diagrams showing results of railway operation with explanatory notes. Also editorial. 6000 w. Ry Age Gaz—Dec. 30, 1910. No. 19846.

Valuation.

Physical Valuation and Capitalization. A statement by Prof. Frank Haigh Dixon, which refutes a statement made by Clifford Thorne, to the effect that railways in the states where valuations have been made are over-capitalized. 4000 w. Ry Age Gaz—Jan. 20, 1911. No. 20351.

STREET AND ELECTRIC RAILWAYS

STREET AND ELECTRIC RAILWAYS.

Boston.

Twelve Years' Development of Rapid Transit in Boston: The Extensions and Additions of the Boston Elevated Railway Co. Map and outline of developments since 1898. 1500 w. Eng News—Jan. 26, 1911. No. 20618.

Cars.

New Rolling Stock for the District Railway. Gives exterior and interior views of the new steel cars, with drawings and description. 700 w. Engr, Lond Jan. 13, 1911. No. 20521 A.

Controllers.

The Thomson-Houston-Sprague System of Multiple-Unit Control (Equipement à Unités Multiples. Systéme Thomson-Houston-Sprague). J. A. Montpelier. A detailed analysis of the system of connections. Ills. 2000 w. L'Elecn—Dec. 3, 1910. No. 20418 D.

Depreciation.

A Discussion of the Depreciation Problem, with Particular Reference to Electric Railways. William B. Jackson. 5000 w. Engng-Con—Feb. 8, 1911. No. 20902.

Electric Traction.

Jarman's System of Electric Traction. Historical account of a storage battery system that was proved practical in 1886. 1000 w. Sci Am Sup—Jan. 14, 1911. No. 20175.

The Economy of Proper Working Weights in Electric Traction (Wirtschaftliche Betriebsgewichte und überra-

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schende Ersparnisse durch ihre Anwendung bei Zugkraftanlagen). Herr Beyer. Discusses this subject with special reference to street railways. 2300 w. Elek Kraft u Bahnen—Dec. 4, 1910. No. 20493 D.

Franchises.

See Subways, under STREET AND ELECTRIC RAILWAYS.

Interurban.

The Washington, Baltimore & Annapolis Electric Railway. Illustrated description of a 1200-volt d. c. system on a high-speed interurban line. 3000 w. Ry & Engng Rev—Jan. 21, 1911. No. 20383.

Locomotives.

2000 H. P. 15000-Volt Single-Phase Locomotive. Illustrated description of this machine. 1700 w. Elect'n, Lond—Jan. 6, 1911. No. 20248 A.

New York.

The Report of the Citizens' Committee on the New York Rapid Transit Problem. Extracts from the Committee's report, and also from the reports of its subcommittees on Finance and on Engineering. 5000 w. Eng News—Jan. 12, 1911. No. 20141.

Paris.

See Subways, under STREET AND ELECTRIC RAILWAYS.

Pittsburg.

City Transportation Problems: A Report by Bion J. Arnold on the Pittsburg Situation. General discussions are given in the present number. 6000 w. Eng News—Feb. 9, 1911. Serial. 1st part. No. 20919.

Power Economy.

Units per Car Mile. W. Capone. A study of the most economical method of handling cars, the effect of installing meters on cars, etc. 3000 w. Tram & Ry Wld—Jan. 5, 1911 No. 20396 B.

Rack Railways.

The Electrification of the Corcovado Rack Railway, Near Rio de Janeiro (L'Electrification du Chemin de Fer à Crémaillère du Mont Corcovado, près Rio de Janeiro). Georges Zindel. Describes the new rolling stock recently installed. Ills. 2500 w. Génie Civil—Dec. 24, 1910. No. 20431 D.

Rail Corrugation.

Corrugation of Rails. J. H. Briggs. Describes experiments showing that the climbing action of the wheel on the rail permits periodic movements. 4500 w. Elect'n, Lond—Jan. 13, 1911. No. 20502 A.

Rates.

The Adjustment of American Street Railway Rates to the Expansion of City Areas. George H. Davis. A statement of conditions and a discussion of fare limits. 2500 w. Elec Ry Jour—Feb. 4, 1911. No. 20806.

Single Phase.

The Lyons-Jons and Lyons-Miribel High-Tension Single-Phase Tramways (Les Tramways à Courant monophasé haute Tension de Lyon à Jons et à Miribel). O. Lombard-Gerin. Brief description of the line equipment and rolling stock. Ills. 3000 w. Génie Civil—Dec. 3, 1910. No. 20424 D.

Subways.

The Paris Subway System—With Special Reference to Franchise Terms and Conditions. Robert H. Whitten. Detailed account of the method in Paris of dealing with the subway problems. Map. 9800 w. Eng News—Jan. 19, 1911. No. 20287.

The Paris Nord-Sud Underground Electric Railway (Le Chemin de Fer électrique souterrain Nord-Sud de Paris). A. Dumas. A comprehensive review of the engineering features, with map. Ills. 9500 w. Génie Civil—Dec. 10, 1910. No. 20426 D.

Switzerland.

The Lugans-Tesserete Electric Railway (Die elektrische Bahn Lugano-Tesserete). Brief description of this 1000-volt direct current line. Ills. Serial. 1st part. 1600 w. Schweiz Bau—Dec. 10, 1910. No. 20463 B.

Transfer Tables.

Flush Transfer Table in Kansas City Railway Shops. Illustrations, drawings and description of interesting details. 500 w. Elec Ry Jour—Jan. 28, 1911. No. 20658.

Trolley Maintenance.

Inspection and Maintenance of Overhead Lines. M. Otto. Summary of information from 110 replies to questions sent out, showing diversity in practice. Ills. 12000 w. Tram & Ry Wld—Jan. 5, 1911. No. 20397 B.

Valuation.

A Logical Basis for Valuations of Interurban Street Railways. C. G. Young. From a paper read before the Cent. Elec. Ry. Assn. Explains the purpose of valuation, discussing the fair rate of return, and the principal methods used in valuations of properties. 5000 w. Eng News—Feb. 2, 1911. No. 20822.

Logical Basis for Valuations of Interurban Street Railways. C. G. Young. Abstract of paper before the Cent. Elec. Ry. Ass'n. Analysis of the purposes of a valuation, method of determining a fair rate of return, the principal methods used in valuations of properties, etc. 3000 w. Elec Ry Jour—Jan. 21, 1911. No. 20295.

Vienna.

The Electrification of the Vienna Stadtbahn (Referat zur Frage der Elektrifizierung der Wiener Stadtbahn). J. Seidener. Paper and discussion before the Vienna Electrical Society. Points out the advantages of electrical operation of the municipal railway. Ills. 6400 w. Elektrotech u Maschinenbau—Dec. 11, 1910. No. 20498 D.

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EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Engineer. *w.* London.
Electrical Engineering. *w.* London.
Elec. Review and W. Elec'n. *w.* Chicago.
Electrical Review. *w.* London.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Am. Soc. of Engineering-Contractors. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis. U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Southern Electrician. *w.* Atlanta, Ga.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Electric Trains.

Electric Trains. By H. M. Hobart. Size, 8½ by 5½ in.; pp., xix, 201. Ills. Price, $2.50. New York: D. Van Nostrand Company.

In this volume, Mr. Hobart confines his treatment of the subject of electric traction to electric trains for city and suburban service, presumably reserving electric locomotives for consideration in a future work. The work is a thoroughly practical discussion of the main factors governing the design and operation of electric trains and can be recommended as a condensed, but at the same time comprehensive and lucid, presentation of the subject. Especial interest attaches to Mr. Hobart's exposition of the method of arriving at the approximate cost of electrical equipment and operation, which he believes is here rationally set forth for the first time.

Municipal Chemistry.

Municipal Chemistry. Edited by Charles Baskerville. Size, 9 by 6 in.; pp., 526. Ills. Price, $5. New York and London: McGraw-Hill Book Company.

A series of thirty lectures by experts on the application of the principles of chemistry to the city, delivered at the College of the City of New York during 1910. The list of lecturers and the subjects with which they dealt is as follows: Charles Baskerville—sanitation and the city; William Pitt Mason — drinking water and disease, and water purification; Alfred Douglas Flinn—the Catskill water supply for New York City; Thomas C. Darlington—milk; Harvey W. Wiley—food adulteration (two lectures); William Allen Hamor—food inspection; Virgil Coblentz—drug adulteration (two lectures); Lyman F. Kebler—habit-forming agents; Allerton S. Cushman—streets and roads (two lectures); William H. Edwards—street sanitation; Edward D. Very—street cleaning and waste disposal (three lectures); C. E. A. Winslow—sewage disposal; Arthur H. Elliott—illuminating gas (two lectures); Payn B. Parsons—the smoke problem; Herbert R. Moody—ventilation; Thomas A. Storey—personal hygiene; Louis A. Olney—textile materials; A. A. Breneman—combustibles and explosives (two lectures); Maximilian Toch—paint, corrosion of iron and steel, and cement and concrete; and Nathaniel Lord Britton—parks, gardens and playgrounds.

Rock Drills.

Rock Drills: Design, Construction and Use. By Eustace M. Weston. Size, 9 by 6 in.; pp., 367. Ills. Price, $4. New York and London: McGraw-Hill Book Company.

The author's object in preparing this book has been to describe the leading modern makes of English, Australian and American drills of both piston and hammer types, and to give such details of their actual use in metalliferous mines as will enable a novice to approach them with some previous knowledge, and also will assist the engineer and mine manager to choose machines best suited to his particular needs and to maintain and work them at their highest efficiency. While he has not hesitated to borrow freely from the writings of others, much of the work is based upon his own experience in working many of the drills described. He has consistently kept in view the needs of the practical man, and while the book may be open to criticism for the omission of some subjects and the scant treatment given to others, we know of no more useful and exhaustive work on the subject of rock drills. The chapter headings are: Historical Sketch; Standard Piston Drills; Hammer Drills; Electric Drills; Operating Rock Drills on the Surface and Underground; Piston Drills Designed to Use Air Expansively; Philosophy of the Process of Drilling Rock; Repair and Maintenance of Rock Drills; Drill Steel and Drill Bits; Explosives and Their Use; Theory of Blasting with High Explosives; Examples of Rock Drill Practice, Africa, Australia and America; Rock Drill Tests and Contests; Dust and Its Prevention; and Notes on the Use of Compressed Air.

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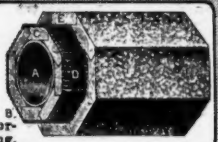

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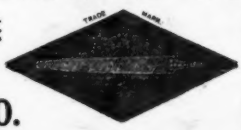

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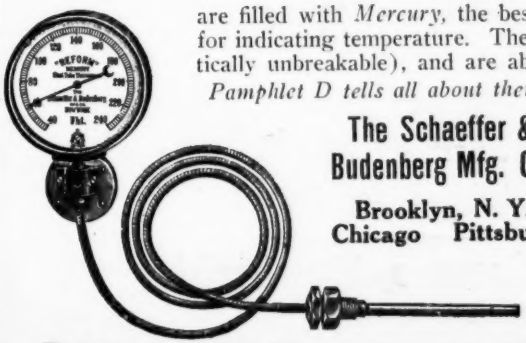

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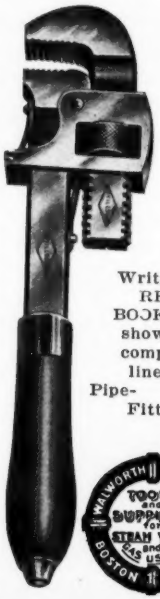

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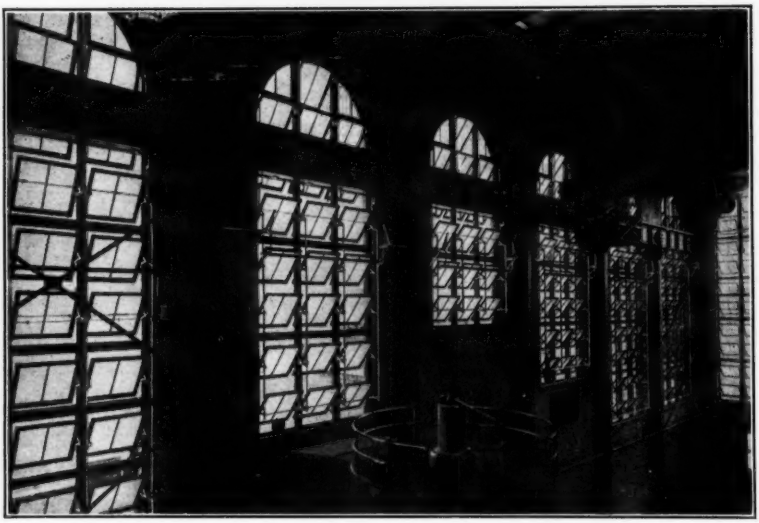

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FRANZ ERICH JUNGE-HERMSDORF, PH.D. *(Monopoly and Progress)*—Educated in civil and mechanical engineering at Charlottenburg, Germany; received degrees of Doctor of Philosophy and Political Economy at the University of Erlengen; for some time practiced as consulting engineer in London and New York; at present commercial counselor to the conservative party, Berlin, Germany; member of the Verein Deutscher Ingenieure; author of "Gas Power," "Die Auswerkung der Kohlen," "Amerikanische Wirtschaftspolitik."

EDWIN C. ECKEL *(A Comparative Study of the Cement and Iron Industries)*—Born New York City, 1875; graduated (C. E.) New York University, 1896; 1895-1898, field work in surveying and masonry construction; 1899-1901, assistant N. Y. State Geological Survey; 1901-1905, assistant geologist U. S. Geological Survey; 1906-1907, geologist in charge of investigations of iron ores and structural materials; resigned from U. S. Geological Survey in 1907 to take up private practice as consulting engineer and geologist on matters relative to iron ores and cement materials. Author of "Cements, Limes and Plasters," "Cement Materials and Cement Industries of the U. S.," and of many papers on engineering and economic geology; associate, American Society of Civil Engineers; member, Society of Chemical Industry; fellow, Geological Society of America.

W. O. HORSNAILL *(A Simple System for Jobbing and Repair Shops)*—Four years as pupil with Messrs. Piercy & Co., Birmingham, manufacturers of steam engines, pumps, and machinery, and engaged also in jobbing work; draftsman with several well-known firms and in charge of a large drafting office for Messrs. Ferranti, Ltd.; manager of engine department of the same firm; chief draftsman Messrs. Crompton & Co., Ltd., who employ more than 1,000 men in the manufacture of dynamos, motors and electrical apparatus; closely associated with reorganisation of both the latter named plants; for six years past in consulting engineering practice at Ipswich, specialising in works organisation, having served many firms in this capacity.

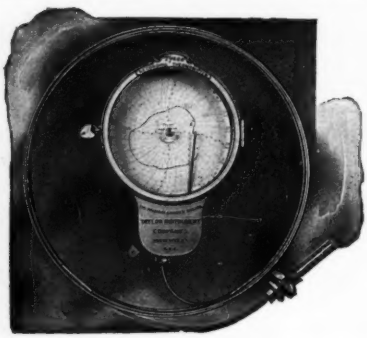
LEO LOEB *(Purchase of Coal by Specifications)*—Born at Rich Hill, Mo., 1885; graduated from the University of Missouri, 1906 (A.B.); Massachusetts Institute of Technology, 1908 (B.S. and M.E.); junior engineer, Coal Inspection Bureau, United States Geological Survey, Washington, 1908-9; Bureau of Mines, Washington, D. C., and Norfolk, Va., 1910; assistant in mechanical engineering, Rensselaer Polytechnic Institute, Troy, N. Y.

AUTHORS AND PAPERS FOR MARCH, 1911

J. MENDENHALL *(Accounting and Cost-Keeping System of the United States Navy)*—Educated Martinsburg, W. Va.; served about four years at the machinist and wood-working trades; obtained about nine years' training in cost and general accounting with several corporations, including the Westinghouse Electric & Mfg. Co.; in 1906 joined the staff of Messrs. Marwick, Mitchell & Co., chartered accountants, of New York, as manager of their industrial department, embracing all lines of cost-accounting, production, engineering, and plant appraisal; is also a certified accountant, and since January 1st, 1910, a partner in the firm above named.

JACQUES BOYER *(Recent Mechanical Improvements in the Manufacture of Illuminating Gas)*—Born in Paris, Dec. 6, 1869; educated at the Faculté des Sciences, Paris, 1890-1893; a regular contributor to *Cosmos*, *La Nature*, *Le Revue Scientifique*, and many other periodicals in France and elsewhere; author of several scientific books, member of the Association Française pour l'Avancement des Sciences and of the Société des Gens de Science; for some years past established as professor of engineering and consulting engineer at 5 *bis*, Rue St. Paul, Paris.

HARRINGTON EMERSON *(The Twelve Principles of Efficiency)*—Born in Trenton, New Jersey, 1853. Educated in Europe, receiving the degree of M. A. at the Royal Polytechnic at Munich, Bavaria; professor at the State University of Nebraska, 1875; engaged in engineering work on the Burlington & Missouri R. R. in 1886, and later engaged in making many inspections and preparing reports on important engineering and mining work in the United States, Mexico and Alaska. Recently with the American Locomotive Company in a similar capacity; originated and developed the efficiency system of wage payment. Consulting engineer, the Emerson Company, New York City.



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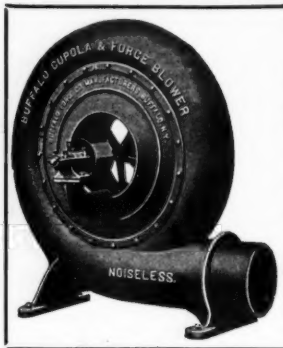

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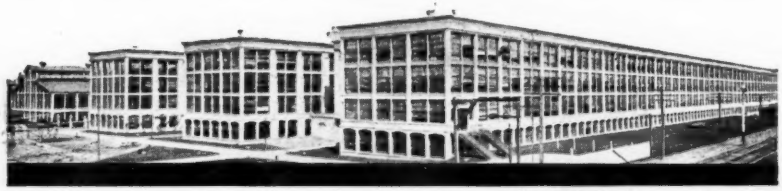

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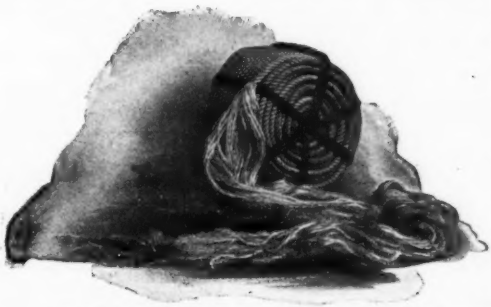
"AMERICAN"

The Value of a Transmission Rope



is measured by the amount of work you can get out of every dollar's worth—not by the first cost.

The essential requirements of a first-class driving rope are:

Reliability, Durability, No Stretch.

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It is stretched in process of manufacture and is self-lubricating.

Write for our **Blue Book of Rope Transmission.**

AMERICAN MANUFACTURING COMPANY

LARGEST WORKERS OF FIBRE IN THE WORLD.

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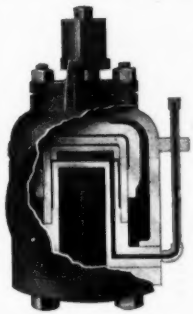
TRANSMISSION ROPE

They cannot leak!



Rothchild Rotary Gate Valves **cannot leak,** and require no repairs or adjustments

This we Guarantee

Economy, Long Life, Efficiency

Send for booklet

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Tannate Belting Saves Stoppage

The strength and flexibility of Tannate Leather make it last longer, saving stoppage for repairs and replacement.

The thorough and permanent stretch of the belts lessens stoppage for take-ups.

Besides this, its flexibility and cling minimize slipping, and consequent loss of power and output.

Write for our new Catalogue G.

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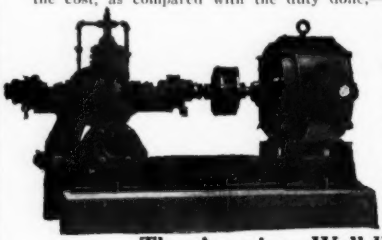
It's neither first cost nor efficiency.

It's the total cost after a period of years when you've figured all the cost, as compared with the duty done,—first cost, attendance cost and up-keep cost. What's the total expense? That's the question.



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Made in over 50 styles and equipped with any power.

Write for General Centrifugal Pump catalog No. 117.

The American Well Works

Chicago Office: First National Bank Building.
General offices and Works: Aurora, Ill., U. S. A.

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of a Rope Drive is absolutely dependent upon the rope. Cheap rope will destroy the value of a drive quicker than any other one thing.

COLUMBIAN

Manila Transmission Rope is made of carefully selected Manila fibre imported for this special purpose from the Island of Cebu. It is as durable as it is possible to make Manila rope. It will wear the longest on *your* drive.

COLUMBIAN ROPE CO.

1317-1359 Genesee St. **Auburn, N. Y.**

The Buyers' Directory

OF

The Engineering and Machinery Trades

NOTE—The display advertisement of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index. See page 11.

Abrasive Material (Alundum).
Norton Co., Worcester, Mass.

Abrasive Materials.
Carborundum Co., Niagara Falls, N.Y.

Accumulators, Hydraulic.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., William, Phila.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila., Pa.

Acid Proof Coating.
Glidden Varnish Co., Cleveland, O.

Advertising.
Manufacturers' Publicity Corp., N. Y.

Air and Gas Compressors.
American Compressor & Pump Co., New York.
Curtis & Co., Mfg. Co., St. Louis.
De La Vergne Mach. Co., New York.
Ingersoll-Rand Co., New York.
McGowan Co., John H., Cincinnati.
Mietz, August, New York.
Norwalk Iron Wks., Norwalk, Conn.
Platt Iron Works Co., Dayton, O.

Air Brakes.
National Brake & Electric Co., Milwaukee, Wis.
Westinghouse Air Brake Co., Pittsburg.

Air Drills.
American Compressor & Pump Co., New York.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.

Air Hoists.
American Compressor & Pump Co., New York.
Brown Hoisting Mchy Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.

Air Motors.
Ingersoll-Rand Co., New York.

Air Receivers.
American Compressor & Pump Co., New York.
Graver Tank Works, Wm., Chicago.
Scaife & Sons Co., Wm. B., Pittsburg.

Air Tube Heaters.
Harrison Eng'g Co., New York.

Air Washers & Humidifiers.
Buffalo Forge Co., Buffalo.
Carrier Air Conditioning Co. of Amer., New York.
Webster & Co., Warren, Camden, N. J.

Alarms, High and Low.
Industrial Instrument Co., Foxboro, Mass.
Sims Co., Erie, Pa.
Wright Mfg. Co., Detroit.

Alcohol Engines.
Foos Gas Engine Co., Springfield, O.

Alternators.
Fort Wayne Electric Works, Fort Wayne, Ind.
Triumph Electric Co., Cincinnati, O.

Ammeters.
Bristol, Co., Waterbury, Conn.
Western Electric Co., Chicago.
Weston Elec. Inst. Co., Waverly Pk., Newark, N. J.

Anchors, Screw.
Star Expansion Bolt Co., New York.

Anti-Friction Metals.
Magnolia Metal Co., New York.
Phosphor Bronze Smelting Co., Phila.
Poole Eng. & Mach. Co., Baltimore.

Asphalt.
American Asphaltum & Rubber Co., Chicago.

Asphalt Floors—Mastic.
American Asphaltum & Rubber Co., Chicago.

Automatic Governors for Air Compressors.
Westinghouse Air Brake Co., Pittsburg.

Automatic Grab Buckets.
Hayward Co., New York.
Hunt Co., C. W., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Automatic Weighing Machines.
Richardson Scale Co., New York.

Automobile Drop Forgings.
Chicago Drop Forge & Foundry Co., Kensington, Ill.

Babbitt Metals.
Magnolia Metal Co., New York.

Ballast Unloaders.
Bucyrus Co., 5th, Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.

Ball Bearings.
American Ball Co., Providence.

Band Saws.
Fay & Egan Co., J. A., Cincinnati.

Bearing Metal.
Magnolia Metal Co., New York.
Phosphor Bronze Smelting Co., Philadelphia.

Belt Conveyors.
Boston Belting Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Rhoads & Sons, J. E., Philadelphia.
Robins Conveying Belt Co., New York.

Belt Dressing (Waterproof).
Dixon Crucible Co., Jos., Jersey City.

Belting.
Boston Belting Co., Boston.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Rhoads & Sons, J. E., Philadelphia.
Simmons Co., Jno., New York.

Belt Dressing.
Rhoads & Sons, J. E., Philadelphia.

Belt Lacing.
Bristol Co., Waterbury, Conn.
Rhoads & Sons, J. E., Philadelphia.
Robins Conveying Belt Co., New York.

Bending Rolls.
Niles-Bement-Pond Co., New York.
Sellers Co., Inc., William, Phila.

Blast Furnaces.
Kennedy, Walter, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg.
Tiprett & Wood, Phillipsburg, N. J.

Blowers.
American Blower Co., Detroit.
American Gas Furnace Co., N. Y.
Buffalo Forge Co., Buffalo.
Crocker-Wheeler Co., Ampere, N. J.
Green Fuel Economizer Co., Mattenwan, N. Y.
Massachusetts Fan Co., Watertown, Mass.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

Blue Print Machines.
Williams, Brown & Earle, Inc., Philadelphia.

Boiler Feeders.
Powell Co., Wm., Cincinnati.

Boiler Fronts and Fittings.
Continental Iron Wks., Brooklyn.
McGowan Co., John H., Cincinnati, O.
Powell Co., Wm., Cincinnati.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.

Boiler Inspection and Insurance.
Fidelity & Casualty Co., New York.

Boilers.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Babcock & Wilcox Co., New York.
Franklin Boiler Wks. Co., New York.
Graver Tank Works, Wm., Chicago.
Harrison Safety Boiler Wks., Phila.
Heine Safety Boiler Co., St. Louis.
Holyoke Steam Boiler Works, Holyoke, Mass.
Lidgerwood Mfg. Co., New York.
Morris Co., I. P., Philadelphia.
Oil Well Supply Co., Oswego, N. Y.
Petroleum Iron Works Co., Sharon, Pa.

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Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburgh.
Smith & Son Co., Sam'l, Paterson, N. J.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.

Boiler Settings.

Harbison Walker Refractories Co., Pittsburg, Pa.

Bolt and Nut Machinery.

Niles-Bement-Pond Co., New York.

Bolt, Nut and Rivet Mfrs.

Orenstein-Arthur Koppel Co., Pittsburg, Pa.
Star Expansion Bolt Co., New York.

Bolts, Toggle.

Star Expansion Bolt Co., New York.

Boosters.

Crocker-Wheeler Co., Ampere, N. J.
Triumph Electric Co., Cincinnati, O.

Boring Mills.

Niles-Bement-Pond Co., New York.
Sellers Co., William, Inc., Phila.

Brakes (Electric).

Electric Controller & Mfg. Co., Cleveland, O.

Brakes—Friction.

Elec. Controller & Mfg. Co., Cleveland.

Brass Founders' Supplies.

Obermayer Co., S., Cincinnati.

Brass Makers' Lathes.

Am. Tool & Machine Co., Boston.
Niles-Bement-Pond Co., New York.

Brick.

Harbison Walker Refractories Co., Pittsburg, Pa.
Maurer & Son, Henry, New York.

Brick and Tile Machinery.

American Blower Co., Detroit.
Jeffrey Mfg. Co., Columbus.

Bridges, Roofs, etc.

Brown Hoisting Mchy. Co., Cleveland.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.
Wellman-Seaver-Morgan Co., Cleveland.

Bronze Bearings.

Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Bronze Vanadium.

American Vanadium Co., Pittsburg.

Bucket Elevators.

Dodge Mfg. Co., Mishawaka, Ind.
Hayward Co., The, New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Robins Conveying Belt Co., New York.
Webster Mfg. Co., Chicago.

Buckets—Dredging & Excavating.

Bucyrus Co., Sth. Milwaukee, Wis.
Hayward Co., New York.
Link Belt Co., Philadelphia, Pa.
Wellman-Seaver-Morgan Co., Cleveland.

Buildings, Iron, Steel and Steel Concrete.

Brown Hoisting Mchy. Co., Cleveland.
Link Belt Co., Philadelphia, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburgh.

Building Papers.

Hydrex Felt & Engineering Co., New York.

Bulldozers.

Niles-Bement-Pond Co., New York.
Wood & Co., R. D., Phila., Pa.

Cable-Railway Machinery.

Hunt Co., C. W., New York.
Poole Eng'g & Mch. Co., Baltimore
Robins Conveying Belt Co., New York.

Cables, Elec. & Submarine.

General Electric Co., New York
Western Electric Co., Chicago.

Cableways—

Flory Mfg. Co., S. Bangor, Pa.
Lambert Hoist Eng. Co., Newark, N. J.
Lidgerwood Mfg. Co., New York.

Cables, Wire.

Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Carbide of Silicon.

Carborundum Co., Niagara Falls, N.Y.

Carborundum.

Carborundum Co., Niagara Falls, N.Y.

Carborundum Paper & Cloth.

Carborundum Co., Niagara Falls, N.Y.

Cars.

Hunt Co., C. W., New York.
Link Belt Co., Philadelphia, Pa.
Orenstein-Arthur Koppel Co., Pittsburg, Pa.
Wellman-Seaver-Morgan Co., Cleveland.

Car Dumpers.

Wellman-Seaver-Morgan Co., Cleveland.

Car Shop Machinery.

Fay & Egan Co., J. A., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Wood & Co., R. D., Phila., Pa.

Castings, Brass, Bronze & Composition.

D'Este Co., Julian, Boston.
Morris Co., I. P., Philadelphia.
Phosphor Bronze Smelting Co., Phila.
Triumph Electric Co., Cincinnati, O.

Castings, Iron & Steel.

Bruce-Macbeth Engine Co., Cleveland.
Caldwell & Son Co., H. W., Chicago.
Chester Steel Castings Co., Philadelphia.
Curtis & Co. Mfg. Co., St. Louis.
Flagg & Co., Stanley G., Phila.
Fox & Co., Jno., New York.
Hooven Owens Rentschler Co., Hamilton, O.
Jeffrey Mfg. Co., Columbus.
Morris Co., I. P., Philadelphia.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Poole Eng'g & Mch. Co., Baltimore.
Powell Co., Wm., Cincinnati.
Riter-Conley Mfg. Co., Pittsburg.
Simmons Co., John, New York.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Walworth Mfg. Co., Boston.
Wellman Seaver-Morgan Co., Cleveland.
Wood & Co., R. D., Phila., Pa.

Castings, Monel Metal.

Bayonne Casting Co., Bayonne, N. J.

Cast-Iron Pipe.

Fox & Co., John, New York.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila., Pa.

Cement, Iron.

Obermayer Co., S., Cincinnati.

Cement Machinery.

Bradley Pulverizer Co., Boston.
Caldwell & Sons Co., H. W., Chicago.
Dunning, W. D., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Robins Conveying Belt Co., New York.
Ruggles-Coles Eng'g Co., New York.

Cement, Portland.

Alsen's Am. Portland Cement Co., New York.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Lehigh Portland Cement Co., Allentown, Pa.
Sandusky Portland Cement Co., Sandusky, O.

Chains.

Diamond Chain & Mfg. Co., Indianapolis.
Link Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.

Chain Belting.

Caldwell & Sons Co., H. W., Chicago.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.

Chain Hoists.

Yale & Towne Mfg. Co., New York.

Chain Joint.

Morse Chain Co., Ithaca, N. Y.

Chain Machinery.

Baird Machine Co., Oakville, Conn.

Chain Pipe & Fittings Wrenches.

Walworth Mfg. Co., Boston.

Channeling Machines.

Ingersoll-Rand Co., New York.

Checks, Time, Pay & Trade.

Schwerdtle Stamp Co., Bridgeport.

Chimneys, Radial Brick and Concrete.

Kellogg Co., M. W., New York, N. Y.

Chucks.

Almond Mfg. Co., Ashburnham, Mass.
American Tool & Mach. Co., Boston.
Niles-Bement-Pond Co., New York.

Circuit Breakers.

Electric Controller & Mfg. Co., Cleveland, O.

Clamps, Cable.

Star Expansion Bolt Co., New York.

Clocks.

Industrial Instrument Co., Foxboro, Mass.

Clutch Pulleys.

American Pulley Co., Philadelphia.
Caldwell & Sons Co., H. W., Chicago.
Link Belt Co., Philadelphia, Pa.
Philips Pressed Steel Pulley Wks., Philadelphia.
Wellman Seaver-Morgan Co., Cleveland.

Coal- and Ash-Handling Machinery.

Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Sons Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Exeter Machine Wks., Pittston, Pa.
Hayward Co., New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link Belt Co., Philadelphia, Pa.
Orenstein-Arthur Koppel Co., Pittsburg, Pa.
Robins Conveying Belt Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

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Coal Cutters (Air and Electric).

Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.

Coal and Ore Bunkers.

Morris Co., I. P., Philadelphia.

Coal-Mining Machinery.

Exeter Machine Works, Pittston, Pa.
General Electric Co., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Engine Co., Newark
Lidgerwood Mfg. Co., New York.
Link Belt Co., Philadelphia, Pa.
McGowan Co., John H., Cincinnati.
Norwalk Iron Wks., So. Norwalk, Ct.
Platt Iron Works Co., Dayton, O.
Robins Conveying Belt Co., New York.
Vulcan Iron Works, Wilkes-Barre, Pa.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Coal Screens.

Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Robins Conveying Belt Co., New York.

Cocks.

Industrial Instrument Co., Foxboro, Mass.
Powell Co., Wm., Cincinnati.
Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.
Wright Mfg. Co., Detroit.

Coil Pipe.

National Pipe Bending Co., New Haven.
Simmons Co., Jno., New York.

Coke-Oven Machinery.

Wellman-Seaver-Morgan Co., Cleveland.

Concrete Mixers.

Dunning, W. D., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.

Concrete Piles.

Simmons Co., John, New York.

Concrete Reinforcing.

American Steel & Wire Co., Chicago.

Concrete Waterproofing.

American Asphaltum & Rubber Co., Chicago.

Condensers.

Alberger Condenser Co., New York.
McGowan Co., John H., Cincinnati.
Platt Iron Works Co., Dayton, O.
Sims Co., Erie, Pa.
Wheeler Condenser & Eng'g Co., N.Y.

Conduit Fibre.

Fibre Conduit Co., Orangeburg, N. Y.

Continuous Elevators.

Caldwell & Son Co., H. W., Chicago.

Contractors, General.

White & Co., J. G., New York.

Controllers, Electric.

Elec. Controller & Mfg. Co., Cleveland.

Conveying Machinery.

Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Sons Co., H. W. Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Exeter Machine Wks., Pittston, Pa.
Hayward Co., The, New York.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link Belt Co., Philadelphia, Pa.
Maris Bros., Philadelphia.
Robins Conveying Belt Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Wellman-Seaver-Morgan Co., Cleveland.

Cooling Towers.

De La Vergne Mach. Co., New York.
Stocker, George J., St. Louis.
Wheeler Condenser & Eng'g Co., Carteret, N. J.

Copper Gaskets.

Simmons Co., Jno., New York.

Cordage.

American Mfg. Co., New York.

Core Compound.

Obermayer Co., S., Cincinnati.

Corliss Engines.

Hooven-Owens-Rentschler Co., Hamilton, O.
Wellman Seaver-Morgan Co., Cleveland.

Cost Systems.

Cooper & Co., John Alex. Chicago, Ill.

Couplings.

Almond Mfg. Co., Ashburnham, Mass.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Sellers & Co., Inc., Wm., Phila.
Walworth Mfg. Co., Boston.

Couplings, Flexible.

Electric Controller & Mfg. Co., Cleveland, O.

Cranes.

Brown Hoisting Machy. Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Hayward Co., The, New York.
Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Link Belt Co., Philadelphia, Pa.
Maris Bros., Philadelphia.
Niles Bement Pond Co., New York.
Obermayer Co., S., Cincinnati.
Northern Engineering Works, Detroit, Mich.
Riter Conley Mfg. Co., Pittsburg.
Sellers & Co., Inc., Wm., Phila.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Wellman-Seaver-Morgan Co., Cleveland.
Wood & Co., R. D., Phila.

Crane Motors.

Triumph Electric Co., Cincinnati, O.
Western Electric Co., Chicago.

Crucibles.

Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Crushers, Ore, Phosphate, Rock.

Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

Cupolas.

Obermayer Co., S., Cincinnati.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.

Cupro Vanadium.

American Vanadium Co., Pittsburg.

Cutters, Milling.

Pratt & Whitney Co., Hartford.

Cylinders.

Graver Tank Works, Wm., Chicago.
U. S. Cast Iron Pipe & Fdy. Co., New York.

Damper Regulator.

D'Este Co., Julian, Boston.
Kitts Manufacturing Co., Oswego, N. Y.

Deadening Felt.

Hydrex Felt & Engineering Co., New York.

Derricks and Fittings.

Brown Hoisting Mchy. Co., Cleveland.
Lidgerwood Mfg. Co., New York.
Northern Engineering Works, Detroit.

Die Castings.

Franklin Mfg. Co., Syracuse, N. Y.

Digesters.

Holyoke Steam Boiler Works, Holyoke, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.

Doors, Hollow Metal.

Dahlstrom Metallic Door Co., Jamestown, N. Y.

Draft Gauges.

Industrial Instrument Co., Foxboro, Mass.

Draft, Mechanical.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Massachusetts Fan Co., Watertown, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.

Drafting Room Equipment.

Altemeier & Sons, Theo., Philadelphia, Pa.
Kelsey, D. J., New Haven, Conn.
Queen & Co., Inc., Philadelphia, Pa.

Drilling Machines.

American Tool Wks. Co., Cincinnati, Ohio.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Inc., William, Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills, Brick and Stone.

Star Expansion Bolt Co., New York.

Drills, Diamond Core.

Ingersoll-Rand Co., New York.

Drills, Extension.

Star Expansion Bolt Co., New York.

Drills, Holders.

Star Expansion Bolt Co., New York.

Drills, Pipe and Star.

Star Expansion Bolt Co., New York.

Drills, Rail.

Niles-Bement-Pond Co., New York.

Drills—Rock and Coal.

Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.

Drop Forgings.

Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Wyman & Gordon Co., Worcester, Mass.

Dryers.

Ruggles-Coles Engng. Co., New York.

Drying Apparatus.

American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Dumps, Automatic.

Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.

Dust Preventive.

American Asphaltum & Rubber Co., Chicago.

Dynamite.

Du Pont De Nemours Powder Co., E. I., Wilmington, Dela.
Keystone National Powder Co., Emporium, Pa.
National Powder Co., Emporium, Pa.
Sinnamahoning Powder Co., Emporium, Pa.

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Dynamometers.
Sprague Electric Co., New York.

Dynamos.
Crocker-Wheeler Co., Ampere, N. J.
Fort Wayne Electric Wks., Fort Wayne, Ind.
Garwood Electric Co., Garwood, N. J.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Ejectors.
Watson & McDaniel Co., Philadelphia.

Elbows, Pipe.
Walworth Mfg. Co., Boston.

Electric Bells.
Western Electric Co., Chicago.

Electric Fault Finders.
Electric Controller & Mfg. Co., Cleveland, O.

Electric Heating Apparatus.
Simplex Elec. Heating Co., Cambridgeport, Mass.

Electric Hoists.
Brown Hoisting Mchy. Co., Cleveland.
Exeter Machine Works, Pittston, Pa.
Hunt Co., C. W., New York.
Lambert Hoist Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Sprague Electric Co., New York.
Vulcan Iron Works, Wilkes-Barre, Pa.
Wellman Seaver-Morgan Co., Cleveland.
Western Electric Co., Chicago.

Elec. Light & Power Plants.
De La Vergne Mach Co., New York.
Foos Gas Engine Co., Springfield, O.
Mietz Iron Fdy. & Mach. Wks., August, New York.

Electrical Furnaces.
Engelhard, Charles, New York.

Elec. Measuring Instruments.
Bristol Co., Waterbury, Conn.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Elec. Welding Outfits.
Garwood Electric Co., Garwood, N. J.

Elevating and Conveying
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Exeter Machine Wks., Pittston, Pa.
Hunt Co., C. W., New York.
Industrial Wks., Bay City, Mich.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Link Belt Co., Philadelphia, Pa.
Maris Bros., Philadelphia.
Northern Engineering Works, Detroit.
Robins Conveying Belt Co., New York.
Webster Mfg. Co., Chicago.

Elevator Insurance.
Fidelity & Casualty Co., New York.

Elevators.
Caldwell & Son Co., H. W., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Dodge Mfg. Co., Mishawaka, Ind.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Obermayer Co., S., Cincinnati.
Poole Eng'g Mch. Co., Baltimore.

Elevator Motors.
Triumph Electric Co., Cincinnati, O.

Employers' Liability Insurance.
Fidelity & Casualty Co., New York

Engineering Instruments.
Alteneder & Sons, Theo., Phila.
Brandis Sons Co., Brooklyn.
Bristol Co., Waterbury, Conn.
Industrial Instrument Co., Foxboro, Mass.
Queen & Co., Philadelphia.

Engineering Specialties.
D'Este Co., Julian, Boston.
Industrial Inst. Co., Foxboro, Mass.
Powell Co., Wm., Cincinnati.

Engineers.
Arnold Co., Chicago.
Baum & Co., Frank G., San Francisco.
Brill & Gardiner, Chicago.
Byllesby & Co., H. M., Chicago.
Dodge, Day & Zimmermann, Philadelphia, Pa.
Harrison Eng'g Co., New York.
Kennedy, Julian, Pittsburg.
Kennedy, Walter, Pittsburg.
Link Belt Co., Philadelphia, Pa.
McClure, Son & Co., G. W., Pittsburg.
Moses, P. R., New York.
Porter, H. F. J., New York.
Robinson, A. W., Montreal, Canada.
Rockker, H. B., New York.
Rogers, John I., New York.
Stone & Webster Eng'g Corp., Boston.
Thomson, T. Kennard, New York.
Universal Audit Company, New York.
Wellman Seaver-Morgan Co., Cleveland.
White & Co., J. G., New York.

Engines—Blowing.
Bruce-Macbeth Engine Co., Ohio.
Wellman-Seaver-Morgan Co., Cleveland.

Engines, Gas & Gasoline.
(See Gas and Gasoline Engines).

Engines, Marine.
De La Vergne Mach Co., New York.
Mietz, August, New York.

Engines, Steam.
American Blower Co., Detroit.
American Engine Co., Bound Brook, N. J.
Ball Engine Co., Erie, Pa.
Brown Hoisting Mchy. Co., Cleveland.
Buffalo Forge Co., Buffalo.
Harrisburg Fdy. & Mch. Wks., Harrisburg, Pa.
Hooven-Owens-Rentschler Co., Hamilton, O.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Skinner Engine Co., Erie, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse, Church, Kerr & Co., New York.
Westinghouse Mch. Co., Pittsburg.

Evaporators.
Wheeler Condenser & Eng'g. Co., Carteret, N. J.

Excavators.
Bucyrus Co., Sth. Milwaukee, Wis.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O
Robins Conveying Belt Co., New York.

Exhaust Heads.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, Ohio.
Industrial Inst. Co., Foxboro, Mass.
McGowan Co., John H., Cincinnati, O.
Sims Co., Erie, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

Exhaust Heads (Cast Iron).
Hoppes Mfg. Co., Springfield, O.
Sims Co., Erie, Pa.

Explosives.
Du Pont-De Nemours Powder Co., E. I., Wilmington, Del.
Keystone National Powder Co., Emporium, Pa.
National Powder Co., Emporium, Pa.
Simmamahoning Powder Co., Emporium, Pa.

Fans, Electric.
Sprague Electric Co., New York.
Western Electric Co., Chicago.

Fans, Ventilating.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Massachusetts Fan Co., Watertown, Mass.
Power Specialty Co., New York.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

Feed Water Filters.
Ross Valve Mfg. Co., Troy, N. Y.

Feed Water Heaters and Purifiers.
Alberger Condenser Co., New York.
Booth Co., L. M., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
McGowan Co., John H., Cincinnati.
National Pipe Bending Co., New Haven.
Petroleum Iron Wks. Co., Sharon, Pa.
Platt Iron Works Co., Dayton, O.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.
Sims Co., Erie, Pa.
Stewart Heater Co., Buffalo, N. Y.
Webster & Co., Warren, Camden, N. J.
Wheeler Condenser & Eng'g Co., Carteret, N. J.

Feed Water Regulators.
Kitts Mfg. Co., Oswego, N. Y.
Williams Gauge Co., Pittsburgh, Pa.

Felt Roofing.
Barrett Mfg. Co., New York.
Hydrex Felt & Engineering Co., New York.

Fences.
Anchor Post Iron Works, New York.

Fence Posts.
Anchor Post Iron Works, New York.

Ferro Vanadium.
American Vanadium Co., Pittsburg.

Fibre Rods, Tubes, Washers, etc.
Diamond State Fibre Co., Elsmere, Del.

Fibre Conduit.
Fibre Conduit Co., Orangeburg, N. Y.

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Files and Rasps.
Barnett Co., G. & H., Phila.
Delta File Works, Philadelphia.
Nicholson File Co., Providence.

Filter Presses.
Am. Tool & Machine Co., Boston.
Niles-Bement-Pond Co., New York.
Platt Iron Works Co., Dayton, O.

Filters.
Booth Co., L. M., New York.
Ross Valve Mfg. Co., Troy.
Scaife & Sons Co., Wm. B., Pittsburg.

Filters, Oil.
Industrial Inst. Co., Foxboro, Mass.
Sims Co., Erie, Pa.
Wright Mfg. Co., Detroit.

Fire Brick
Harbison Walker Refractories Co., Pittsburg, Pa.
Maurer & Son, Henry, New York.
Obermayer Co., S., Cincinnati.

Fire Clay.
Carborundum Co., Niagara Falls, N. Y.
Harbison Walker Refractories Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati.

Fire Door Equipment.
Dahlstrom Metallic Door Co., Jamestown, N. Y
Kinnear Mfg. Co., Columbus, O.

Fire Hose.
Boston Belting Co., Boston.
Simmons Co., John, New York.

Fireproof Building Materials.
Maurer & Son, Henry, New York.

Fittings.
Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.

Fittings, Ammonia.
De La Vergne Mach. Co., New York.

Fittings, Electric Crane.
Electric Controller & Mfg. Co., Cleveland, O.

Flanges.
McGowan Co., John H., Cincinnati, O.
Walworth Mfg. Co., Boston.

Flexible Shafts.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.
Almond Mfg. Co., Ashburnham, Mass.

Floor and Sidewalk Lights.
Brooks & Co., T. H., Cleveland.

Fly Wheels.
Bruce-Macbeth Engine Co., Cleveland, O.
Dodge Mfg. Co., Mishawaka, Ind.
Poole Eng'g & Mch. Co., Baltimore.
Wellman Seaver-Morgan Co., Cleveland.

Forges.
Buffalo Forge Co., Buffalo.
Ingersoll-Rand Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Iron and Steel.
Bruce-Macbeth Engine Co., Cleveland, O.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.
Wyman & Gordon, Worcester.

Forgings, Monel Metal.
Bayonne Casting Co., Bayonne, N. J.

Forgings, Vanadium.
American Vanadium Co., Pittsburg.

Forming and Bending Mchy.
Baird Machine Co., Oakville, Conn.

Foundry Equipment.
American Blower Co., Detroit.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit.
Obermayer Co., S., Cincinnati.
Platt Iron Works Co., Dayton, O.

Foundry Riddles.
Obermayer Co., S., Cincinnati.

Foundry Supplies.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati.

Friction Clutches.
American Pulley Co., Philadelphia.
Am. Tool & Mch. Co., Boston.
Caldwell & Son Co., H. W., Chicago.
Link Belt Co., Philadelphia, Pa.
Poole Eng'g & Mch. Co., Baltimore.
Pyott Co., Chicago.
Wellman Seaver-Morgan Co., Cleveland.

Fuel Economizers.
Green Fuel Economizer Co., Matteawan, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Furnace Builders.
Am. Gas Furnace Co., New York.
Continental Iron Works, Brooklyn.
Hawley Down Draft Furnace Co., Chicago, Ill.
Kennedy, Julian, Pittsburg.
McClure, Son & Co., G. W., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, N. J.
Wellman Seaver-Morgan Co., Cleveland.

Fused Silica Wire.
Engelhard, Charles, New York.

Gages—Pressure, Steam, Water.
Bristol Co., Waterbury, Conn.
Industrial Inst. Co., Foxboro, Mass.
Powell Co., Wm., Cincinnati.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Walworth Mfg. Co., Boston.
Wright Mfg. Co., Detroit.

Galvanized Sheet Steel.
Inland Steel Co., Chicago.

Galvanometers.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Gas Blowers & Exhausters.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Platt Iron Works Co., Dayton, O.
Sturtevant Co., B. F., Hyde Park, Mass.

Gas Engine Indicators.
Industrial Instrument Co., Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

Gas & Gasoline Engines.
Bruce-Macbeth Engine Co., Cleveland, O.
Buckeye Engine Co., Salem, Ohio.
De La Vergne Machine Co., N. Y.
Foos Gas Engine Co., Springfield, O.
Hooven-Owens-Rentschler Co., Hamilton, O.
Mietz, August, New York.
Turner Fricke Mfg. Co., Pittsburg, Pa.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.

Gas Machines & Generators.
Am. Gas Furnace Co., New York.
Morgan Const. Co., Worcester.
Wood & Co., R. D., Phila., Pa.

Gas Producers.
Bruce-Macbeth Engine Co., Cleveland, O.
De La Vergne Machine Co., New York.
Foos Gas Engine Co., Springfield, O.
Morgan Construction Co., Worcester.
Power & Mining Mchy. Co., Milwaukee.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Machine Co., Pittsburg.
Wood & Co., R. D., Phila., Pa.

Gaskets.
Boston Belting Co., Boston.

Gear Cutting Machines.
Gleason Works, Rochester, N. Y.
Pratt & Whitney Co., Hartford.

Gearing.
Bilgram Machine Wks., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Gleason Works, Rochester, N. Y.
Franklin Mfg. Co., Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
New Process Rawhide Co., Syracuse.
Poole Eng'g & Mch. Co., Baltimore.
Sellers Co., Inc., Wm., Phila.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Gears, Vanadium.
American Vanadium Co., Pittsburg.

Generating Sets.
American Blower Co., Detroit.
American Engine Co., Bound Brook, N. J.
Buffalo Forge Co., Buffalo.
Crocker-Wheeler Co., Ampere, N. J.
De La Vergne Machine Co., New York.
Mietz, August, New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Electric Co., Cincinnati, O.

Gold Dredging Machinery.
Bucyrus Co., Sth. Milwaukee, Wis.
Marion Steam Shovel Co., Marion, Ohio.
Wellman-Seaver-Morgan Co., Cleveland.

Graphite.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.

Grate Bars.
Bruce-Macbeth Engine Co., Cleveland, O.

Grinding Machinery.
Dodge Mfg. Co., Mishawaka, Ind.

Grinding & Polishing Mchy.
Crocker-Wheeler Co., Ampere, N. J.
Helwig Mfg. Co., St. Paul.
Landis Tool Co., Waynesboro, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Grinding & Pulverizing Mchy
Bradley Pulverizer Co., Boston.
Dunning, W. D., Syracuse.
Wellman-Seaver-Morgan Co., Cleveland.

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Grinding Wheels.
Carborundum Co., Niagara Falls, N. Y.

Grinding Wheels (Alundum).
Norton Co., Worcester, Mass.

Hack Saws.
Niles-Bement-Pond Co., New York.

Hammers, Electric.
Helwig Mfg. Co., St. Paul.

Hardware Machinery.
Baird Machine Co., Oakville, Conn.

Heating Furnaces.
Wellman-Seaver-Morgan Co., Cleveland.

Heating and Ventilating Apparatus.
American Blower Co., Detroit.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Eng'g Co., New York.
Hitchings & Co., New York.
Lord & Burnham Co., Irvington-on-Hudson, N. Y.
Simmons Co., John, New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.

Hoisting Engines and Mchy.
Brown Hoisting Mchy. Co., Cleveland.
Bruce-Macbeth Engine Co., Ohio.
Exeter Machine Wks., Pittston, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Foos Gas Engine Co., Springfield, O.
Hayward Co., New York.
Hunt Co., C. W., New York.
Industrial Works, Bay City, Mich.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Link Belt Co., Philadelphia, Pa.
Mietz, August, New York.
Northern Engineering Works, Detroit.
Robins Conveying Belt Co., New York.
Sellers Co., Wm., Inc., Philadelphia.
Shepard Electric Crane & Hoist Co., Montour Falls, New York.
Vulcan Iron Works, Wilkes-Barre, Pa.
Wellman Seaver-Morgan Co., Cleveland.

Hoisting Rope.
American Mfg. Co., New York.
Hunt Co., C. W., New York.

Hose.
Boston Belting Co., Boston.
Simmons Co., John, New York.

Hot Water Generators.
Sims Co., Erie, Pa.

Hydraulic Fittings.
McGowan Co., John H., Cincinnati, O.
Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.

Hydraulic Gauges.
Bristol Co., Waterbury, Conn.
Industrial Inst. Co., Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Hydraulic Leather.
Rhoads & Sons, J. E., Philadelphia.

Hydraulic Machinery.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., John H., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Platt Iron Works Co., Dayton, O.
Rife Engine Co., New York.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila., Pa.

Hydraulic Presses.
McGowan Co., John H., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Platt Iron Works Co., Dayton, O.
Wood & Co., R. D., Phila., Pa.

Hydraulic Rams.
Pelton Water Wheel Co., San Francisco.
Power Specialty Co., New York.
Rife Engine Co., New York.

Hydraulic Turbines.
Leffel & Co., James Springfield, Ohio.
Morris Co., I. P., Philadelphia.
Platt Iron Works Co., Dayton, O.
Wellman-Seaver-Morgan Co., Cleveland, Ohio.

Ice-Mak'g & Refriger. Mchy.
De La Vergne Machine Co., N. Y.
Roelker, H. B., New York.

India Oil Stones.
Norton Co., Worcester, Mass.

Indicators.
Detroit Lubricator Co., Detroit.
Industrial Inst. Co., Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn.

Industrial Railways.
Hunt Co., C. W., New York.

Ingots.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Injectors.
Detroit Lubricator Co., Detroit.
Powell Co., Wm., Cincinnati.
Sellers & Co., Inc., Wm., Philadelphia.

Insulating Material.
American Asphaltum & Rubber Co., Chicago.

Insulation, Electric.
Diamond State Fibre Co., Elsmere, Del.
Fibre Conduit Co., Orangeburg, N. Y.

Insurance.
Fidelity & Casualty Co., New York.

Iron & Steel Tubular Poles.
Simmons Co., John, New York.

Jacks, Hydraulic.
Watson-Stillman Co., New York.

Keyseaters.
Niles-Bement-Pond Co., New York.

Keyseat Milling Machine.
National Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.

Lace Leather.
Rhoads & Sons, J. E., Philadelphia.

Lamps, Electric.
Adams-Bagnall Electric Co., Cleveland.
Cooper-Hewitt Electric Co., New York.
General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Lathes.
Am. Tool & Mch. Co., Boston.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers Co., Wm., Inc., Philadelphia.

Leather Packing.
Detroit Leather Specialty Co., Inc., Detroit, Mich.
Rhoads & Sons, J. E., Philadelphia.

Lifting Magnets.
Elec. Controller & Mfg. Co., Cleveland.

Lights, Floor & Sidewalk.
Brooks & Co., T. H., Cleveland.

Lockers, Steel.
Darby & Sons Co., Edward, Philadelphia, Pa.

Locomotive Cranes.
Brown Hoisting Mchy. Co., Cleveland.
Exeter Machine Wks., Pittston, Pa.
Industrial Works, Bay City, Mich.
Northern Engineering Works, Detroit.
Wellman Seaver-Morgan Co., Cleveland.

Locomotives.
Baldwin Locomotive Works, Phila.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Orenstein-Arthur Koppel Co., Pittsburg, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Logging Machinery.
Lidgerwood Mfg. Co., New York.

Low Water Indicators.
Detroit Lubricator Co., Detroit.

Lubricants.
Dixon Crucible Co., Jos., Jersey City.
Obermayer Co., S., Cincinnati.
Powell Co., Wm., Cincinnati.

Lubricators.
Detroit Lubricator Co., Detroit.
Greene, Tweed & Co., New York.
Powell Co., Wm., Cincinnati.

Machinery, Second Hand.
Niles-Bement-Pond Co., New York.

Machinists' Small Tools.
Pratt & Whitney Co., Hartford.

Magnesia Brick Cement.
Harbison Walker Refractories Co., Pittsburg, Pa.

Magnesite.
Harbison Walker Refractories Co., Pittsburg, Pa.

Malleable Castings.
Jeffrey Mfg. Co., Columbus, O.

Marine Boilers.
Morris Co., I. P., Philadelphia.

Metal Sheets.
Bayonne Casting Co., Bayonne, N. J.

Meters, Electric.
General Electric Co., New York.
Western Electric Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, Newark, N. J.

Milling Machines.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.

Mill Supplies.
Dodge Mfg. Co., Mishawaka, Ind.
Powell Co., Wm., Cincinnati.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.

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Mine Cars.
Hunt Co., C. W., New York.
Jeffrey Mfg. Co., Columbus.
Orenstein-Arthur Koppel Co., Pittsburg, Pa.
Wellman-Seaver-Morgan Co., Cleveland.

Mining Machinery.
Bradley Pulverizing Co., Boston.
Brown Hoisting Mchy. Co., Cleveland.
Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Hunt Co., C. W., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
McGowan Co., John H., Cincinnati.
Norwalk Iron Wks. Co., Norwalk, Ct.
Platt Iron Works Co., Dayton, O.
Power & Mining Mchy. Co., Milwaukee.
Power Specialty Co., New York.
Robins Conveying Belt Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Monel Metal Castings.
Bayonne Casting Co., Bayonne, N. J.

Motors, Electric.
Crocker-Wheeler Co., Ampere, N. J.
Fort Wayne Electric Works, Fort Wayne, Ind.
Garwood Electric Co., Garwood, N. J.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
Triumph Electric Co., Cincinnati.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Moulding Machines.
Obermayer Co., S., Cincinnati.
Power Specialty Co., New York.

Name Plates.
Schwerdtle Stamp Co., Bridgeport.

Naphtha Gas Machines.
Am. Gas Furnace Co., New York.

Office Furniture.
Globe-Wernicke Co., Cincinnati, O.

O. H. Furnaces.
Wellman-Seaver-Morgan Co., Cleveland.

O. H. Furnace Charge Machinery.
Wellman-Seaver-Morgan Co., Cleveland.

Ohmmeters.
Weston Elec. Instrument Co., Waverly Park, Newark, N. J.

Oil Burners.
Hauck Mfg. Co., Brooklyn, N. Y.
Petroleum Iron Wks. Co., Sharon, Pa.

Oil and Grease Cups.
Detroit Lubricator Co., Detroit.
Walworth Mfg. Co., Boston.

Oil Engines.
De La Vergne Machine Co., N. Y.
Mietz, August, New York.

Oil—Lubricating.
Kellogg & Co., E. H., New York.

Oil Refining Plants.
Graver Tank Works, Wm., Chicago.
Petroleum Iron Wks. Co., Sharon, Pa.

Oil Pumps.
Detroit Lubricator Co., Detroit.
Wood & Co., R. D., Phila., Pa.

Oil Stones.
Carborundum Co., Niagara Falls, N. Y
Norton Co., Worcester, Mass.

Oil Tanks.
Chicago Bridge & Iron Wks., Chicago.
Wood & Co., R. D., Phila., Pa.
Wright Mfg. Co., Detroit.

Ore Unloaders.
Wellman-Seaver-Morgan Co., Cleveland.

Ore and Coal Bridges.
Hunt Co., C. W., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Packing.
Boston Belting Co., Boston.
Jenkins Bros., New York.
Link Belt Co., Philadelphia, Pa.

Paint Graphite.
Obermayer Co., S., Cincinnati.

Paints—Structural.
American Asphaltum & Rubber Co., Chicago.

Paints and Varnishes.
Dixon Crucible Co., Jos., Jersey City.
Hydrex Felt & Engineering Co., New York.

Paper-Mill Machinery.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holyoke Steam Boiler Works, Holyoke, Mass.
Jeffrey Mfg. Co., Columbus.
Platt Iron Works Co., Dayton, O.
Robins Conveying Belt Co., New York.

Patent Attorneys.
Dieterich, C. A., New York.
Evans & Co., Victor J. Washington, D. C.

Pattern-Makers' Machinery.
Fay & Egan Co., J. A., Cincinnati.
Pratt & Whitney Co., Hartford.

Pavement Filler.
American Asphaltum & Rubber Co., Chicago.
Barrett Mfg. Co., New York.

Pavement—Wood.
U. S. Wood Preserving Co., New York.

Paving—Asphalt.
American Asphaltum & Rubber Co., Chicago.

Penstocks.
Graver Tank Works, Wm., Chicago.
Holyoke Steam Boiler Works, Holyoke, Mass.
Petroleum Iron Works Co., Sharon, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Perforated Metal.
Caldwell & Son Co., H. W., Chicago.

Phosphor Bronze.
Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pile Drivers.
Ingersoll-Rand Co., New York.
Lidgerwood Mfg. Co., New York.

Pin Machinery.
Baird Machine Co., Oakville, Conn.

Pinions.
New Process Raw Hide Co., Syracuse.

Pipe.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Fibre Conduit Co., Orangeburg, N. Y.
Fox & Co., Jno., New York.
Petroleum Iron Wks. Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Simmons Co., Jno., New York.
U. S. Cast Iron Pipe & Fdy. Co., New York.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila., Pa.
Wyckoff & Son Co., A., Elmira, N. Y.

Pipe Bends.
National Pipe Bending Co., New Haven.
Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.

Pipe Coating.
American Asphaltum & Rubber Co., Chicago.

Pipe-Cutting and Threading Machines.
Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Co., Bridgeton, N. J.
Niles-Bement-Pond Co., New York.
Saunders' Sons, Inc., D., Yonkers.
Walworth Mfg. Co., Boston.

Pipe Flanging and Expanding Machines.
Loveklu Pipe Expanding & Flanging Mch. Co., Philadelphia, Pa.

Pipe—Spiral Riveted.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Graver Tank Works, Wm., Chicago.

Pipe Coverings.
Wyckoff & Son Co., A., Elmira, N. Y.

Pipe Fittings, Cast Iron.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Direct Separator Co., Syracuse, N. Y.
Pelton Water Wheel Co., San Francisco.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila., Pa.

Pipe Taps & Reamers.
Walworth Mfg. Co., Boston.

Pitch.
Barrett Mfg. Co., New York.

Planers.
Niles-Bement-Pond Co., New York.
Sellers & Co., William, Phila.

Planing Mill Machinery.
Fay & Egan Co., J. A., Cincinnati.

Pneumatic Tools.
American Compressor & Pump Co., New York.
Curtis & Co. Mfg. Co., St. Louis.
Helwig Mfg. Co., St. Paul.
Ingersoll-Rand Co., New York.

Poles, Iron and Steel Tubular.
Simmons Co., John, New York.

Polishing Blocks & Wheels.
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.

Pop Safety Valves.
McGowan Co., John H., Cincinnati, O
Powell Co., Wm., Cincinanti.

Portable Drilling Machines.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Portland Cement.
See Cement.

Powder—Blasting.
Du Pont De Nemours Powder Co., E. I., Wilmington, Del.
Keystone National Powder Co., Emporium, Pa.
National Powder Co., Emporium, Pa.
Sinnamahoning Powder Co., Emporium, Pa.

Powder Mixers.
Dunning, W. D., Syracuse.

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Power Plant Piping.

Kellogg Co., M. W., New York, N. Y.
National Pipe Bending Co., New Haven, Conn.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.

Power-Transmission Mchy.

Almond Mfg. Co., Ashburnham, Mass.
American Pulley Co., Philadelphia.
Brown Hoisting Mchy. Co., Cleveland.
Caldwell & Son Co., H. W., Chicago.
Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
General Electric Co., New York.
Hayward Co., The, New York.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Morse Chain Co., Ithaca, N. Y.
National Brake & Clutch Co., Boston.
Philips Pressed Steel Pulley Works, Philadelphia.
Platt Iron Works Co., Dayton, O.
Pyott Co., Chicago.
Robins Conveying Belt Co., New York.
Sellers & Co., Inc., William, Phila.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wood & Co., R. D., Philadelphia.

Presses, Sheet Metal Working.

Baird Machine Co., Oakville, Conn.

Pressed Steel Pulleys.

American Pulley Co., Philadelphia.

Presses and Dies.

Armstrong Mfg. Co., Bridgeport, Ct.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
Wood & Co., R. D., Phila., Pa.

Prospecting Drills.

Ingersoll-Rand Co., New York.

Pulleys, Shafting & Hangers

Am. Tool & Machine Co., Boston.
American Pulley Co., Philadelphia.
Caldwell & Son Co., H. W., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., J. A., Cincinnati.
Jeffrey Mfg. Co., Columbus, O.
Philips Pressed Steel Pulley Works, Philadelphia.
Poole Eng'g & Mch. Co., Baltimore.
Pyott Co., Chicago.
Robins Conveying Belt Co., New York.
Sellers & Co., Wm., Philadelphia.

Pulleys, Wrought Steel.

American Pulley Co., Philadelphia.

Pulverizing Mills.

Dunning, W. D., Syracuse.

Pump Governors.

McGowan Co., John H., Cincinnati, O.

Pumping Engines.

McGowan Co., John H., Cincinnati, O
Platt Iron Works Co., Dayton, O.

Pumps and Pumping Machy.

Alberger Condenser Co., New York.
American Compressor & Pump Works, New York.
Buffalo Forge Co., Buffalo.
Cameron Steam Pump Works, N. Y.
De La Vergne Mach Co., New York.
Deming Co., Salem, Ohio.
Emerson Steam Pump Co., Alexandria, Va.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Lawrence Machine Co. Lawrence, Mass.
Lea Equipment Co., New York.
McGowan Co., John H., Cincinnati.
Mietz, August, New York.
Morris Co., I. P., Philadelphia.
Morris Machine Works, Baldwinsville, N. Y.
Pelton Water Wheel Co., Oakland, Cal.
Platt Iron Works Co., Dayton, O.
Rife Engine Co., New York.
Watson-Stillman Co., New York.
Wheeler Condenser & Eng'g Co., Carteret, N. J.
Wood & Co., R. D., Phila., Pa.

Pump Pressure Regulator.

D'Este Co., Julian, Boston.

Pumps, Syphon.

McGowan Co., John H., Cincinnati, O.

Punching & Shearing Mchy.

Buffalo Forge Co., Buffalo.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., William, Phila.
Wood & Co., R. D., Philadelphia.

Pyrometers.

Bristol Co., Waterbury, Conn.
Engelhard, Charles, New York.
Hohmann & Maurer Mfg. Co., Rochester, N. Y.
Queen & Co., Philadelphia.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Taylor Instrument Companies, Rochester, N. Y.

Quarry Machinery.

Brown Hoisting Mchy Co., Cleveland.
Flory Mfg. Co., S., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
McGowan Co., John H., Cincinnati.
Northern Engineering Works, Detroit.
Platt Iron Works Co., Dayton, O.
Robins Conveying Belt Co., New York.

Quartz Glass.

Engelhard, Charles, New York.

Rail Braces.

Rail Joint Co., New York.

Rail Joints.

Rail Joint Co., New York.

Railings.

Anchor Post Iron Works, New York.

Railway Shop Machinery.

Brown Hoisting Mchy. Co., Cleveland.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., J. A., Cincinnati.
Niles-Bement-Pond Co., New York.
Norwalk Iron Works, So. Norwalk, Ct.
Pratt & Whitney Co., Hartford.
Sellers & Co., Inc., William, Phila.
Stow Mfg. Co., Binghamton, N. Y.

Rawhide Gears.

New Process Raw Hide Co., Syracuse.

Razor Hones.

Carborundum Co., Niagara Falls, N. Y.

Ready Roofing.

Barrett Mfg. Co., New York.
Hydrex Felt & Engineering Co., New York.

Reamers.

Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.
Walworth Mfg. Co., Boston.

Resistance Banks and Units.

Elec. Controller & Mfg. Co., Cleveland.

Rheostats.

Simplex Elec. Heating Co., Cambridge, Mass.

Riveting Machines.

Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers Co., Wm., Inc., Phila.
Wood & Co., R. D., Phila., Pa.

Road Preservative.

American Asphaltum & Rubber Co., Chicago.

Rolling Mill Machinery.

Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Morgan Construction Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Roofing.

American Asphaltum & Rubber Co., Chicago.
Barrett Mfg. Co., New York.
Chicago Bridge & Iron Wks., Chicago.
Hydrex Felt & Engineering Co., New York.

Roofing Materials.

American Asphaltum & Rubber Co., Chicago.
Barrett Mfg. Co., New York
Hydrex Felt & Engineering Co., New York.

Rope.

American Mfg. Co., New York.
Columbian Rope Co., Auburn, N. Y.
Hunt Co., C. W., New York.

Rope Transmission.

American Mfg. Co., New York.
Caldwell & Son Co., H. W., Chicago.
Columbian Rope Co., Auburn, N. Y.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Phosphor Bronze Smelting Co., Philadelphia.
Pyott Co., Chicago.

Rubber Goods.

Boston Belting Co., Boston.
Jenkins Bros., New York.

Rubbing and Sharpening Stones.

Norton Co., Worcester.

Sand Mixers and Sifters.

Link Belt Co., Philadelphia, Pa.
Obermayer Co., S., Cincinnati.
Sellers & Co., William, Phila.

Sash Operating Device.

Detroit Steel Products Co., Detroit, Mich.
Hitchings & Co., New York.
Lord & Burnham Co., Irvington-on Hudson, N. Y
Lupton's Sons Co., David, Philadelphia, Pa.

Saw-Mill Machinery.

Curtis & Co. Mfg. Co., St. Louis.
Dodge Mfg. Co., Mishawaka, Ind.
Fay & Egan Co., J. A., Cincinnati.
Jeffrey Mfg. Co., Columbus.

Saws, Hack.

Niles-Bement-Pond Co., New York.

Scales.

Richardson Scale Co., New York.

Screens, Mining.

Jeffrey Mfg. Co., Columbus.
Link Belt Co., Philadelphia, Pa.
Pyott Co., Chicago.

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Screw Machines.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Screw Plates.
Card Mfg. Co., S. W., Mansfield, Mass.
Walworth Mfg. Co., Boston.

Separators, Pneumatic.
Sturtevant Co., B. F., Hyde Park, Mass.

Separators, Steam and Oil.
American Tool & Mch. Co., Boston.
Austin Separator Co., Detroit.
D'Este Co., Julian, Boston.
Direct Separator Co., Syracuse.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield O.

McGowan Co., John H., Cincinnati, O.
Sims Co., Erie, Pa.
Watson & McDaniel Co., Phila.
Webster & Co., Warren, Camden, N.J.
Wright Mfg. Co., Detroit.

Shaft Couplings, Flexible.
Elec. Controller & Mfg. Co., Cleveland

Shapers.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., William, Phila.
Steptoe Shaper Co., John, Cincinnati, O.

Sharpening Stones.
Carborundum Co., Niagara Falls, N.Y.
Norton Co., Worcester, Mass.

Sheathing Papers.
Barrett Mfg. Co., New York.
Hydrex Felt & Engineering Co., New York.

Shop Floors.
U. S. Wood Preserving Co., New York.

Shutters (Fire).
Kinnear Mfg. Co., Columbus.

Skylights.
Van Noorden Co., E., Boston.

Slate Machinery.
Flory Mfg. Co., S., Bangor, Pa.
Morris Co., I. P., Philadelphia.

Special Machinery.
Baird Machine Co., Oakville, Conn.
Bruce-Macbeth Engine Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Spring Coiling Machines.
Baird Machine Co., Oakville, Conn.

Stacks.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
Chicago Bridge & Iron Wks., Chicago.
Graver Tank Works, Wm., Chicago.
Holyoke Steam Boiler Works, Holyoke, Mas.
Petroleum Iron Wks. Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburgh.
Smith & Son Co., Sam'l, Paterson, N. J.
Walsh's Boiler Wks., Holyoke, Mass.

Stamps—Steel, Alphabets and Figures.
Schwerdtle Stamp Co., Bridgeport.

Stand Pipes.
Chicago Bridge & Iron Wks., Chicago.
Graver Tank Works, Wm., Chicago.
Holyoke Steam Boiler Works, Holyoke, Mas.
Petroleum Iron Wks. Co., Sharon, Pa.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.
Wood & Co., R. D., Phila., Pa.

Steam Convertors.
Sims Co., Erie, Pa.

Steam Engine Indicators.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Steam Fitters' Supplies.
Simmons Co., John, New York.

Steam Hammers.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., William, Phila.

Steam-Regulat'n Appliances.
D'Este Co., Julian, Boston.
Harrison Safety Boiler Works, Phila.
Jenkins Bros., New York.
Powell Co., Wm., Cincinnati.
Power Specialty Co., New York.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.

Steam Shovels.
Bucyrus Co., Sth. Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., Boston.

Steam Specialties.
Austin Separator Co., Detroit.
Bayonne Casting Co., Bayonne, N. J.
Industrial Inst. Co., Foxboro, Mass.
Kellogg Co., M. W., New York, N. Y.
McGowan Co., John H., Cincinnati, O.
Powell Co., Wm., Cincinnati.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Simmons Co., John, New York.
Sims Co., Erie, Pa.
Walworth Mfg. Co., Boston.
Wright Mfg. Co., Detroit.

Steam Traps.
Albany Steam Trap Co., Albany, N. Y.
American Blower Co., Detroit.
D'Este Co., Julian, Boston.
Direct Separator Co., Syracuse, N.Y.
Kitts Mfg. Co., Oswego, N. Y.
Morehead Mfg. Co., Detroit, Mich.
Sims Co., Erie, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

Steam Turbines.
Kerr Turbine Co., Wellsville, N. Y.

Steam Fitters' Supplies.
Powell Co., Wm., Cincinnati.
Walworth Mfg. Co., Boston.

Steam Hot Blast Apparatus.
American Blower Co., Detroit.
Sturtevant Co., B. F., Hyde Park, Mass.

Steel.
Inland Steel Co., Chicago.
Jessop & Sons, Wm., New York.
Walworth Mfg. Co., Boston.
Wyman & Gordon, Worcester.

Steel Balls.
American Ball Co., Providence.

Steel Doors.
Dahlstrom Metallic Door Co., Jamestown, N. Y.

Steel, High Speed.
Jessop & Sons, Wm., New York.
Wyman & Gordon, Worcester.

Steel-Plant Machinery.
Wellman-Seaver-Morgan Co., Cleveland.

Steel Plate Construction.
Chicago Bridge & Iron Wks., Chicago.
Graver Tank Works, Wm., Chicago.
Holyoke Steam Boiler Works, Holyoke, Mas.

Steel Sash.
Lupton's Sons Co., David, Philadelphia, Pa.

Steel, Vanadium.
American Vanadium Co., Pittsburg.

Stencils.
Schwerdtle Stamp Co., Bridgeport.

Stokers—Mechanical.
Am. Ship Windlass Co., Providence, R. I.
Babcock & Wilcox Co., New York.
Harrisburg Foundry & Mach. Wks., Harrisburg, Pa.
Under-Feed Stoker Co., Chicago.
Westinghouse Mch. Co., Pittsburg.

Storage Batteries.
Westinghouse Mch. Co., Pittsburg.

Structural Iron Work.
Brown Hoisting Mchy Co., Cleveland.
Chicago Bridge & Iron Wks., Chicago.
Northern Engineering Works, Detroit.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.

Sugar-House Machinery.
Am. Tool & Mch. Co., Boston.
Platt Iron Works Co., Dayton, O.

Sugar Juice Heaters.
Sims Co., Erie, Pa.

Superheaters.
Babcock & Wilcox Co., New York.
Power Specialty Co., New York.

Switchboards.
Crocker-Wheeler Co., Ampere, N. J.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., Chicago.

Switches, Electric.
Electric Controller & Mfg. Co., Cleveland, O.

Tachometers.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Industrial Inst. Co., Foxboro, Mass.

Tanks.
Chicago Bridge & Iron Wks., Chicago.
Dodge Mfg. Co., Mishawaka, Ind.
Graver Tank Works, Wm., Chicago.
Holyoke Steam Boiler Works, Holyoke, Mass.
Petroleum Iron Works Co., Sharon, Pa.
Riter-Conley Mfg. Co., Pittsburg.
Scaife & Sons Co., Wm. B., Pittsburg.
Smith & Son Co., Sam'l, Paterson, N. J.
Tippett & Wood, Phillipsburg, N. J.
Walsh's Boiler Wks., Holyoke, Mass.
Wood & Co., R. D., Phila., Pa.

Taps and Dies.
Card Mfg. Co., S. W., Mansfield, Mass.
Pratt & Whitney Co., Hartford.
Walworth Mfg. Co., Boston.

Temperature Regulators.
D'Este Co., Julian, Boston.

Tenoning Machines.
Fay & Egan Co., J. A., Cincinnati.

Thermometers.
Bristol Co., Waterbury, Conn.
Hohmann & Maurer Mfg. Co., Rochester, N. Y.
Queen & Co., Philadelphia.
Schaeffer & Budenberg Mfg. Co., Brooklyn.
Standard Thermometer Co., Boston, Mass.
Taylor Instrument Companies, Rochester, N. Y.

Thermometers, Dial Type.
Industrial Instrument Co., Foxboro, Mass.

Time Checks.
Schwerdtle Stamp Co., Bridgeport.

Transformers.
Triumph Electric Co., Cincinnati, O.

Trolleys.
Curtis & Co., Mfg. Co., St. Louis.
Maris Bros., Philadelphia.

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Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit.

Trucks.

Orenstein-Arthur Koppel Co., Pittsburg, Pa.

Trucks, Storage Battery Auto.

Westinghouse Mach. Co., Pittsburg.

Tumbling Barrels.

Baird Machine Co., Oakville, Conn.
Northern Engineering Works, Detroit.

Tumbling Mills.

Obermayer Co., S., Cincinnati.

Tubular Poles—Iron & Steel.

Simmons Co., John, New York.

Turbines, Steam.

General Electric Co., Schenectady.
Hooven-Owens Rentschler Co., Hamilton, O.
Kerr Turbine Co., Wellsville, N. Y.
Morris Co., L. P., Philadelphia.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Mch. Co., Pittsburg.
Wheeler Condenser & Eng'g Co., Carteret, N. J.

Turbines, Water.

J. & W. Jolly, Inc., South Holyoke, Mass.
Leffel & Co., James, Springfield, O.
Pelton Water Wheel Co., San Francisco.
Platt Iron Works Co., Dayton, O.
Wellman-Seaver-Morgan Co., Cleveland.

Turn Tables.

Chicago Bridge & Iron Wks., Chicago.
Northern Engineering Works, Detroit.
Sellers & Co., Inc., Wm., Phila.
Tippett & Wood, Phillipsburg, Pa.

Turret Heads.

Almond Mfg. Co., Ashburnham, Mass.

Turret Lathes.

American Tool & Mch. Co., Boston.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Twist Drills.

Pratt & Whitney Co., Hartford.

Unions.

Dart Mfg. Co., E. M. Providence, R. I.
Walworth Mfg. Co., Boston.

Vacuum and Draft Gages.

Bristol Co., Waterbury, Conn.
Industrial Inst. Co., Foxboro, Mass.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Vacuum Pumps.

American Compressor & Pump Co., N. Y.
Buffalo Forge Co., Buffalo.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., John H., Cincinnati.
Platt Iron Works Co., Dayton, O.
Wheeler Condenser & Eng'g Co., Carteret, N. J.

Valves, Blow-off.

Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.

Valves—Gas, Steam and Water.

Bayonne Casting Co., Bayonne, N. J.
D'Este Co., Julian, Boston.
Detroit Lubricator Co., Detroit.
Jenkins Bros., New York.
Kellogg Co., M. W., New York.
McGowan Co., John H., Cincinnati, O.
Powell Co., Wm., Cincinnati.
Ross Valve Mfg. Co., Troy.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
Wood & Co., R. D., Phila., Pa.

Valves, Reducing.

D'Este Co., Julian, Boston.
Kitts Mfg. Co., Oswego, N. Y.
Ross Valve Mfg. Co., Troy, N. Y.
Simmons Co., Jno. New York.
Watson & McDaniel Co., Philadelphia.

Vanadium Alloys.

American Vanadium Co., Pittsburg.

Vanadium Steels.

American Vanadium Co., Pittsburg.

Ventilating Apparatus.

American Blower Co., Detroit.
Bristol Co., Waterbury, Conn.
Buffalo Forge Co., Buffalo.
Green Fuel Economizer Co., Matteawan, N. Y.
Hitchings & Co., New York.
Lord & Burnham Company, New York.
Massachusetts Fan Co., Watertown, Mass.
Sirocco Engng. Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.
Western Electric Co., Chicago.

Vises

Walworth Mfg. Co., Boston.

Voltmeters.

Bristol Co., Waterbury, Conn.
Western Electric Co., Chicago.
Weston Elec. Instrument Co., Waverly Park, Newark.

Water Columns.

Walworth Mfg. Co., Boston.
Wright Mfg. Co., Detroit.

Water Cooling Towers.

Wheeler Condenser & Eng'g. Co., Carteret, N. J.

Waterproofing Concrete Floor Dressing.

Glidden Varnish Co., Cleveland, O.

Waterproofing Materials.

American Asphaltum & Rubber Co., Chicago.
Barrett Mfg. Co.
Hydrex Felt & Engineering Co., New York.

Water Purifying Apparatus.

Booth Co., L. M., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Graver Tank Works, Wm., Chicago.
Harrison Safety Boiler Wks., Phila.
Platt Iron Works Co., Dayton, O.
Scaife & Sons Co., Wm. B., Pittsburg.

Water Softening Apparatus.

Booth Co., L. M., New York.
Dodge Mfg. Co., Mishawaka, Ind.
Graver Tank Works, Wm., Chicago.
Harrison Safety Boiler Wks., Phila.
Northern Water Softener Co., Madison, Wis.
Platt Iron Works Co., Dayton, O.
Scaife & Sons Co., Wm. B., Pittsburg.

Water Towers, Iron & Steel.

Chicago Bridge & Iron Wks., Chicago.
Tippett & Wood, Phillipsburg, N. J.

Water-Wheels.

J. & W. Jolly, Inc., South Holyoke, Mass.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco.
Platt Iron Works Co., Dayton, O.
Poole Eng'g & Mch. Co., Baltimore.
Power Specialty Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.
Wood & Co., R. D., Phila.

Water-Works Pumping Mch.

Buffalo Forge Co., Buffalo.
Foos Gas Engine Co., Springfield, O.
Goulds Mfg. Co., Seneca Falls, N. Y.
McGowan Co., John H., Cincinnati, O.
Platt Iron Works Co., Dayton, O.
Wood & Co., R. D., Phila., Pa.

Water-Works Supplies.

Power Specialty Co., New York.
Simmons Co., John, New York.
Walworth Mfg. Co., Boston.

Welders, Electric Arc.

Electric Controller & Mfg. Co., Cleveland, O.

Well Drilling Machines.

Williams Bros., Ithaca, N. Y.

Well Supplies.

Williams Bros., Ithaca, N. Y.

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Van Noorden Co., E., Boston.

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American Steel & Wire Co., Chicago.

Wire Rope.

Jeffrey Mfg. Co., Columbus.
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Wire Vanadium.

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Wyckoff & Son Co., A., Elmira, N. Y.

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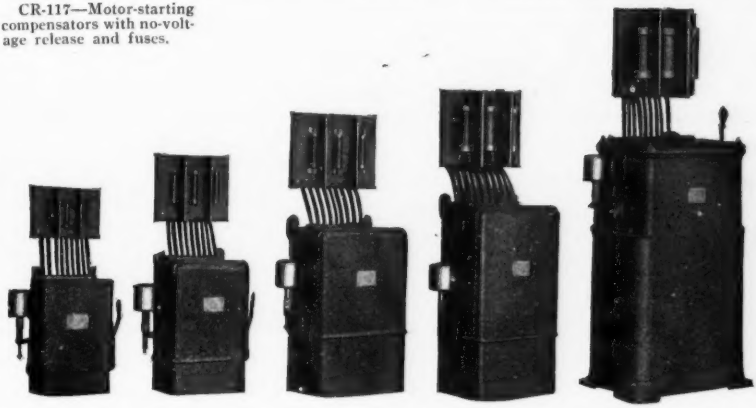
Ingersoll-Rand Co., New York.

Wrenches.

Simmons Co., Jno., New York.
Walworth Mfg. Co., Boston.
Wood & Co., R. D., Phila.

For Alphabetical Index to Advertisers see page 11.

CR-117—Motor-starting compensators with no-voltage release and fuses.



CR-117 Compensators

have no-voltage release and spring return switch

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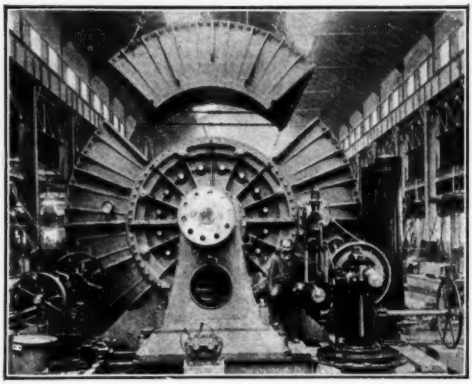

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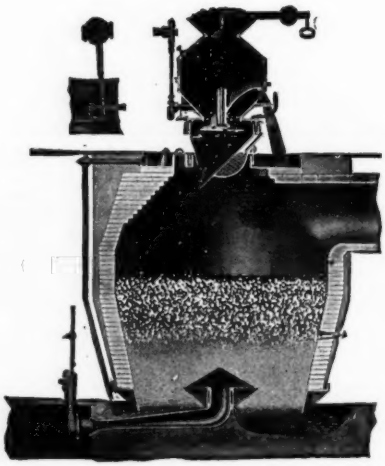

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Automatic Reversing Trippers.

NEW YORK, January 22, 1911.

To the Editor,
The Engineering Magazine.

DEAR SIR:—

Our attention has just been called to an article on Page IX of your department of Improved Machinery for January, describing and illustrating an automatic reversing tripper which, according to the article, is made by the Stephens-Adamson Manufacturing Co. of Aurora, Ill.

This machine is described as a "new" automatic reversing tripper. Your article contains such a full and detailed description of the mechanism that we are able to say with certainty that the device infringes every one of the twelve claims of our Patent No. 673,539 of May 7th, 1901, covering a tripper invented by the late Mr. James Barnes Humphreys, who was for several years the chief engineer of this company. We ask you to examine the picture and description of the tripper referred to in your article and satisfy yourself that there is not a single mechanical detail which is not fully shown and described in our patent of ten years ago, which we send herewith.

Our company has built hundreds of trippers under this patent, every one of which is plainly marked with the patent number. We have also had full sized machines of this type operating at all of the large World's Fairs since the Paris Exposition of 1900, where we received the only Grand Prix which was awarded for conveying machinery. Furthermore, this same tripper is illustrated and described fully in our earlier catalogues. Therefore, we are compelled to attribute to audacity rather than to ignorance, the claims made by the Stephens-Adamson Company in your pages that they are offering a "new" automatic reversing tripper, and that "there has been a great need in certain classes of work for a tripper of this sort."

Several years ago our company discontinued, to some extent, the use of the friction drive for moving the tripper, and substituted wherever it was possible a mechanical equivalent which is absolutely dust-proof, thereby saving our customers the expense of renewing the friction wheels. But the fact that we do not commonly employ a mechanical detail which was tried and found wanting, offers no excuse for any one to use your pages in order to foist upon the public as original and new, a device which has been patented for ten years in every civilized country on the globe, and which has been advertised and sold in large numbers by the most prominent concern in its line of business.

The matter of infringement of our rights is one which we can look after with the help of our attorneys; but the damage, and particularly the annoyance, which we shall suffer from the article in your journal are serious matters. We are sure you will agree that such an article breeds other infringements, and

attracts trade away from those to whom it rightfully belongs. We therefore trust that you will give this letter as much prominence as was accorded in your columns to the article to which we have made objection.

Yours very truly,
ROBINS CONVEYING BELT CO.,
Thomas Robins, President.

The Fort Wayne Rock Drill.

THE Fort Wayne type "A" electric rock drill is the result of several years development and testing under the most severe and unfavorable conditions of actual working operations. Contrasted with designs making use of flexible shafts, solenoids, springs and other complicated devices, the Fort Wayne drill is unusually simple, and consequently it is exceedingly rugged and effective.

This drill is of the rotary hammer type, operated by an electric motor which is mounted on the frame of the drill proper. The mechanism of the drill consists of two parts, a revolving helve containing the hammers, and the chuck mechanism for holding and rotating the drill steel. An idler is conveniently arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus all the advantages of hand drilling are obtained without the disadvantages usually incident to machine drilling.

The drill steel is held in the chuck by means of several spring steel plates. When not striking rock, the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground.

The drill casing, striking mechanism, chuck and buffer plates are all simple and very substantial. The floating hammers in the helve are of special steel and are completely cushioned by air chambers so that the jar of the impacts is reduced to a minimum.

The drill steel cannot be jammed into a fissure or cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge, it has hammered for itself a square shoulder or face, due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring.

Another point of excellence in the

Fort Wayne drill is the simple method employed for the removal of cuttings from the hole being drilled. A special designed steel removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the big item of pressure systems, including tanks, hose, water lines, etc., is eliminated, as well as the cost of maintenance and inconvenience incident to such systems.

While these drills are ordinarily used in a horizontal position, they can be used in any position and will drill holes at any angle.

The ease with which power can be transmitted throughout the workings by wire, and the rapidity with which the lines can be changed, enables the operator to advance his work more rapidly than could be done when using other types of drills. A comparison of tests of the type "A" drill and air drills shows that the former requires about 1½ to 2 horse power, including transmission loss, while an average air drill requires from 12 to 18 horse power for the same work. This is due to the design of the drill, the much greater efficiency of the electric motor, and the small loss in transmitting power to the drill. The simplicity and ruggedness of design of the type "A" drill is a guarantee that the cost of maintenance will be exceedingly low. Owing to the saving in power, the low cost of maintenance and the high efficiency of the Fort Wayne drill, from 50 to 70 per cent. can readily be made, under ordinary conditions, upon the investment.

The drill can be operated with either an AC or DC motor and since the motor is entirely independent of the drill the change from one to the other is easily made.

Bulletin No. 1120 issued by the Fort Wayne Electric Works, 1630 Broadway, Fort Wayne, Ind., illustrates and describes this drill in detail. It is sent free on request.

Automatic Fuel Oil Regulation.

PRACTICALLY all oil fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner, and the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant.

The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Co., Los Angeles, Cal., where under the directions of the chief engineer, one man stationed near the oil pumps, running at practically constant speed, controlled 18 boilers or 54 burners by opening or closing a bleeder valve on the oil pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore automatic fuel oil regulating system. This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners, and the supply of air for combustion, for any number of boilers, all from a central point. The results are increased boiler plant efficiency, the practical prevention of smoke, and the decrease in the maintenance cost of boiler equipment, due to a more uniform manner of firing. This was first installed at the Redondo plant of the Pacific Light & Power Co. in 1907. Here the regulating system is used to control the entire plant of 18 boilers of 600 horse power capacity each, and the increased economy, due to uniform rate of firing, is very evident.

Under actual operating conditions this system of regulation has been found absolutely reliable. In 1909, or about two years after this apparatus was installed, A. C. Balch, general manager of the Pacific Light & Power Co., expressed his opinion in the following letter to the designers:

"As you know, we have in our plant at Redondo, 18 Babcock & Wilcox boilers, each rated at 604 horse power, with three burners per boiler, or 54 burners in all. The entire boiler plant has now been equipped with the Moore automatic fuel oil regulators for the past year, which control the steam pressure, the fuel oil pressure, the supply of steam to burners for atomizing the oil, and the operation of boiler dampers for the purpose of regulating the supply of air for combustion.

"With this system we maintain practically a uniform pressure while in operation. One-third of the plant has been under automatic control for a period of over 18 months. The remainder as stated above, was equipped with your regulators one year ago and the entire plant is now operating under this condition. During this time we have never suffered an interruption of service, or loss of steam pressure, due to failure of regulators to operate; they are simple in design and positive in action and we find them capable of ready adjustment by the operative firemen.

"Our plant is subject to a widely swinging railway load and we find under all conditions the boilers respond to these fluctuations of load almost instantly. As the result of installing this equipment we find the load is more equally divided among all of the boilers in service than under hand firing, and the boilers are free from abuses due to excessive rate of firing periodically experienced with hand regulation on variable load.

"It is usually the case, in attempting to hand regulate fires on reduced air supply, that the chimneys will smoke frequently on variation in loads; as a result of the automatic system of regulation, the smoke nuisance has been reduced to a minimum."

At this time, 1911, after this system has been in operation a number of years, the Southern California Edison Co. is installing a similar outfit. A bulletin "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them," can be obtained on writing to Chas. C. Moore & Co., San Francisco Cal.

Eight Spool Caisson Hoist.

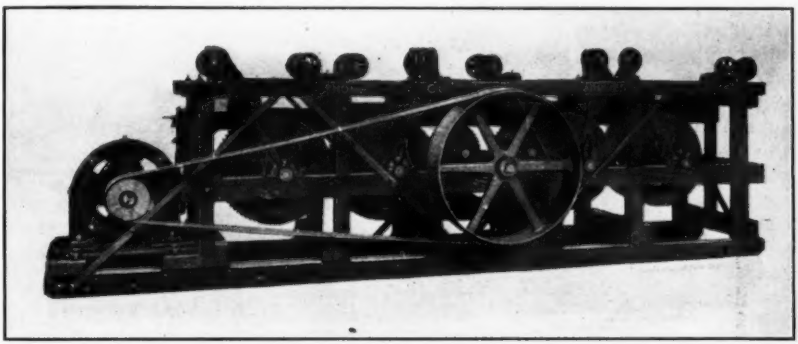
UP to the present time hoisting from caissons has been done with the ordinary hoisting engine equipped with governor and cable driving sheaves. A spool is located at each caisson and an endless cable is carried from the hoist sheave around the several caisson spools operating them in series.

With this equipment it is necessary that the caissons be either aligned or that a combination of sheaves be installed to spring the cable to the proper direction. In this installation a fouled line at any caisson stops all work on the series until the line is straightened or repaired. It not infrequently happens also that the driving cable breaks, with the result that all buckets are precipitated to the bottom and often injuring the workmen. There is another disadvantage in the fact that in the usual work only a part of the caissons are completed at one time and a portion of the plant and workmen must remain idle while the remaining caissons are being finished, or the hoisting from the incompleted caissons must be done by hand.

The improved caisson hoist, shown herewith, obviates all of the above difficulties. The material from each caisson is hoisted independently. There is no

necessity for alignment of caissons as the machine provides a separate hauling line to each caisson and operates with equal facility in any direction. A caisson located at any place in the foundation therefore can be started at any time desired.

Since each caisson is operated independently, any breakage or cessation of work does not interfere in any manner



with the progress in the other caissons. A slow or difficult caisson, also, does not impede the work in the other caissons.

Any hoist speed of load may be had from 0 to 150 feet per minute and the speed is under the absolute control of the operator at the caisson. An accident in any line, therefore, will not affect any other. The hauling line is so carried that it does not slip on a spool and burn out; the slippage is entirely on a friction disc, built for the purpose, and the line and frictions are therefore practically indestructible.

One set up on any ordinary size building is sufficient to complete the job. Caissons located as far as 100 feet radius can be operated with ease.

This hoist is made by Thomas Elevator Co., 20 South Hoyne avenue, Chicago, Ill., who will furnish full information respecting it on request.

Durability of Metal Roofs.

MANUFACTURERS are daily giving more attention to the minimizing of factory costs and the costs of maintenance and general factory wear and tear, and for years big manufacturers have been looking for a roofing material that would stand the exposure to the smoke and grime-laden atmosphere of manufacturing districts. A number of the larger plant owners in various parts of the country are using Toncan Metal, a rust-resisting product made by the Stark Rolling Mill Company of Canton, Ohio, in the roofing of their plants. Among the large factories in the country which have replaced old rust-eaten, corroded iron and sheet steel roofs with Toncan Metal are the Union Rolling Mill Company of Cleveland, Ohio; Ball Brothers, glass manufacturers of Muncie, Ind., and the Seneca Chain Company of Kent, Ohio.

Durability is the chief requisite in a metal roof. It costs thousands of dollars to cover acre after acre of factory roof with steel and iron that offer little resistance to adverse weather and other conditions which work toward early rusting and corrosion. It has been the experience of many that roofing material has had to be replaced yearly. The Union Rolling Mill Company is one of

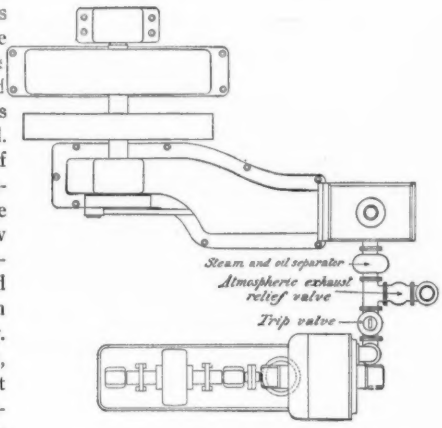
the largest concerns of its kind in the country. In 1907 they adopted Toncan Metal for roofing purposes, 1,300 squares or 130,000 square feet being placed on the factory roof during 1907, 1908, 1909 and 1910. Previous to that time it was necessary to replace portions of the roof on an average of once a year, but since the first installment of this new metal roof it has not been necessary to replace any of it. The roof is as good to-day as it was the day it was put on, because the weather conditions and the sulphurous conditions arising from the mixture of smoke and fumes do not corrode it as did the roofing material previously used.

The Seneca Chain Company, one of the largest chain manufacturing concerns in the world, is erecting a large plant at Kent, Ohio. In erecting a new plant to replace the one recently destroyed by fire, they specified and used Toncan Metal for roofing and siding on the entire plant. The Ball Bros. Mfg. Co., at Muncie, Ind., one of the largest, if not the largest manufacturers of fruit jars, has found it economical to use Toncan Metal sheets not only for roofing and siding on their immense plant but also in connection with their manufacturing operations.

Steam Turbines With Reciprocating Engines.

TO increase the power of a plant where the requirements have slightly outgrown its original capacity is a trying problem that is often made easy by means of the exhaust steam turbine. This is well illustrated for instance in a mill deriving its power from a simple non-condensing engine, and in which the addition of machinery from time to time has increased the load on the engine beyond a practical limit.

Changing the engine to condensing and utilizing the additional range of pressure drop to drive an exhaust steam turbine, not only almost doubles the amount of power previously secured from the engine, but this is done without increasing the duty on the engine and without using more steam than before. Such an installation is illustrated herewith. The initial cost of the turbine and condenser

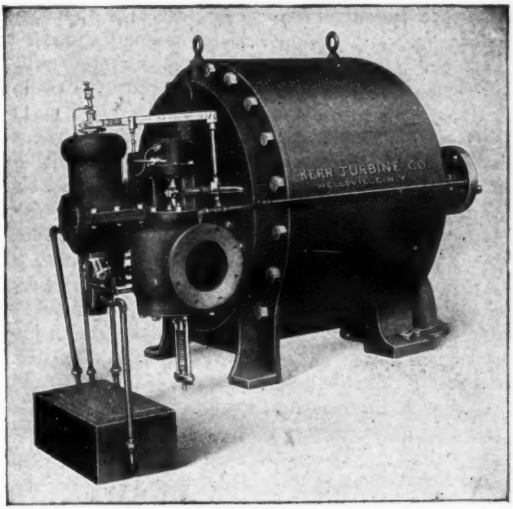


per horse power is less than for additional boiler and engine capacity, and there is not the compulsion to buy more than may be required.

The second illustration shows a Kerr exhaust turbine, made by Kerr Turbine Co., Wellsville, N. Y. This machine operates with any steam pressure above 2 pounds gauge at its inlet and exhausts into a vacuum of from 24 to 28 inches utilizing exhaust from main engine, pumps, air compressors, etc.

The installation of such an exhaust turbine improves the economy most and offers the greatest capacity increase where the turbine and a suitable condenser are added to a simple non-condensing engine. For the smaller sizes the ordinary jet condenser maintaining

24 to 26 inches vacuum may be used with satisfaction. In larger units condensing apparatus maintaining higher vacuum is justified. A substantial improvement in economy and increase in capacity also result from the addition of an exhaust turbine to a simple condensing engine and from the addition of turbine and condenser to a compound non-condensing engine.



In general the steam economy of a simple engine and exhaust steam turbine together is always an improvement over that which would be obtained by compounding and adding a condenser. The plant capacity is increased from 50 to 100 per cent. by exhausting through an exhaust turbine to condenser on a non-condensing engine, while the increase by adding the turbine to a condensing outfit is from one and one-half to three times that which could be secured from the condenser alone.

As an engine and exhaust turbine installation takes no more steam than would the engine alone and under the same conditions as before, there is not an additional penny of expenditure necessary for boilers, chimneys, draft, coal handling apparatus, buildings and steam piping. The turbine and condenser, or turbine alone in a condensing plant, can be cut into the exhaust line without interfering with the engine and usually without otherwise altering the layout of the plant. The installation of the turbine hardly affects plant operating costs as the turbine is adjusted at the factory and seldom requires other attention than occasional lubrication and repacking of stuffing boxes. The oiler who has previously been taking care of the engine can look after the turbine too without any serious drain on his time, for the turbine should run constantly for months without shutdown.

An engine that has previously been running non-condensing, continues to exhaust at about the same pressure and carries the same load after the turbine

is put into the exhaust line. A condensing engine can be adjusted to exhaust at atmospheric pressure or thereabouts and will be relieved of that part of the load assumed between atmospheric pressure and the vacuum while the turbine is being operated. The water of condensation will be discharged from the condenser at a temperature within two or three degrees of the theoretical and can be utilized in the usual ways.

In short, the increase in output obtained from a condensing reciprocating engine and exhaust set is greater by about 25 per cent. than obtainable with any condensing engine alone while the installation of turbine and condenser upon a non-condensing engine increases the output from about 40 to 100 per cent.

Power developed by an exhaust steam turbine is available for driving a generator, centrifugal or air pump, fan or any high speed machine or for belt or silent chain driving, and under much the same conditions as that obtainable from high pressure turbines. Rigged up for belt or chain drive, the exhaust turbine delivers into the same line or jack shaft as the engine, in which case the turbine assumes an almost fixed proportion of the load. Figure 3 is a typical installation of this kind. The output of the turbine may be delivered entirely independent of the engine to drive belted auxiliaries or machinery of any kind, the speed requirements of the driven machine being perfectly met by a conforming pulley ratio.

Cameron-Ingersoll-Rand Consolidation.

THE recent change in the proprietorship of the A. S. Cameron Steam Pump Works from the widow of the founder to the Ingersoll-Rand Company has excited a good deal of attention and some misunderstanding. As a matter of fact the Ingersoll rock drill and the Cameron pump have always been very closely associated, each being about the same age, forty years. In a little shop on the corner of Second avenue and Twenty-second street, New York, both the Ingersoll drill and the Cameron pump originated, and for some years the manufacture of both took place under the same roof. The late Henry C. Sergeant designed the first really successful Ingersoll drill, getting his fundamental ideas of the valve motion from A. S. Cameron This was at a time when even the flywheel engine was more or less of a novelty, and a reciprocating engine, like a pump or rock drill, with no crank shaft to carry it around the center, was practically unknown. The first machines of this class were built on steam engine lines, the valve itself being mechanically connected with the piston. In the first Ingersoll drill, as in the first pump, when the piston reached the end of the stroke it reversed the valve by direct mechanical contact with knuckle joints, rods or other devices, which intervened between the piston and the valve.

Here is where great credit is due to A. S. Cameron. He was seeking to perfect a pump which should be used in rough places where exposed parts were liable to wear and injury. He also wanted to build a valve which would open up a large port at the end of the stroke at the instant that the piston reached a certain point. This was hardly practicable with a mechanically moved valve without excessive shock and wear. Cameron's invention, therefore, was to place a small tappet or knuckle in each cylinder head of the pump, which would serve as a trigger to trip through contact with the piston and open a small port connecting either end of the valve. The valve itself was submerged in live steam pressure equal at both ends, hence when this tripping action took place it reduced the pressure on one end so that the active

pressure on the other caused it to reverse. In order to do this with the minimum shock at the tappet, or with a small trigger action, and also taking into consideration the importance of having a small port controlled by such action, Mr. Cameron used a plunger piston which in turn overlapped the valve itself, this plunger piston having an area on each end which might be greater or smaller according to the resistance of the valve to the action of sliding on its seat. The valve itself was, and still is, a slide valve which, as everybody knows, rests tightly upon its ports and does not leak by wear.

Sergeant had a problem more difficult than Cameron, because, in the first place, the speed of a pump is only about 100 feet per minute, while that of a rock drill is four times as great. This high speed made it difficult to use any kind of a tappet trigger, and in order to get the quickest action of the valve, Sergeant sought to obtain the slide valve and to use the plunger or valve moving device of Cameron as the valve itself. In doing this he ran against another difficulty;—the valve, in order to be tight on its seat, would press so hard that the speed of the drill became sluggish. To overcome this he ran a bolt through the center of this valve, which relieved it of a certain portion of this pressure. Instead of the tappet trigger Sergeant moved his valve by causing the piston of the drill to uncover passages leading to each valve end. Here we have the identical principle, so far as the valve movement is concerned, that is embodied in the Cameron pump, namely, an equal pressure on both ends of the valve and the valve moving through a disturbance of that pressure on one end and the other alternately, the action itself being controlled by the strokes of the piston. No better evidence is needed of the success of this valve action than the fact that the Ingersoll "Eclipse" drill and the Cameron pump are at work today with valves of this construction.

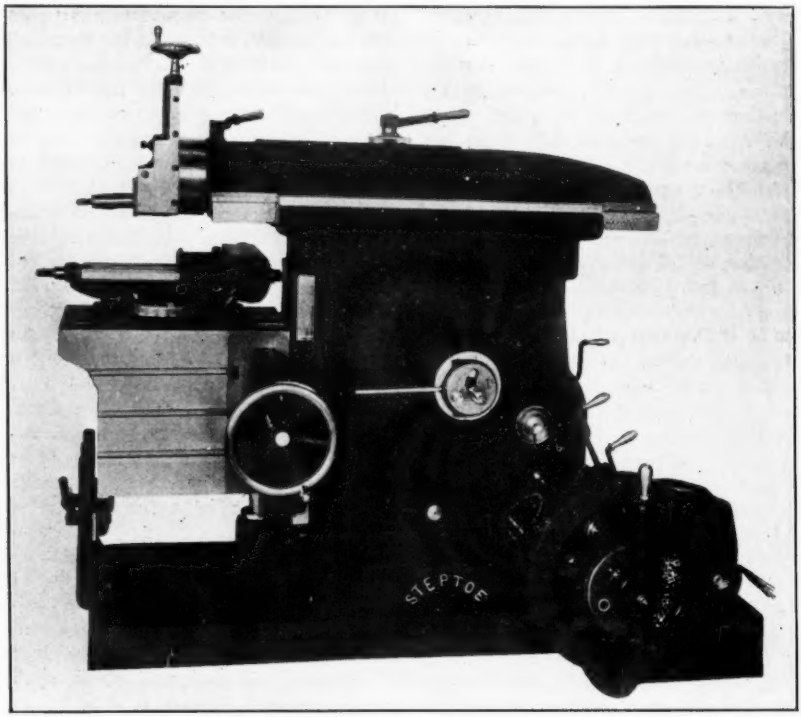
The community of interests between Cameron and Ingersoll has extended from this inception to the present day. The castings for the first air compressors of the Ingersoll make were made in the Cameron foundry on East Twenty-second street. For many years, and until the Ingersoll works were moved to Easton, Pa., the castings were made by Cameron. The success of the Cameron pump in mines, quarries and for contractor's service, brought it close to the Ingersoll business. In South Africa, and other places, the Ingersoll-Rand agents have been the agents for the Cameron pump.

Adam Scott Cameron graduated from Cooper Institute and applied himself to mechanical matters. He was engaged in building the Sewell and Cameron crank and flywheel pump, which during the Civil War was in demand by the United States Navy and the Merchant Marine. At the close of the war the call for these pumps fell off so that Mr. Cameron turned his attention to the design of a pump of greater adaptability and more general application. The standard Cameron pump was the result, its acorn-shaped air chamber, the emblem of the clan Cameron, the oak, being his trade mark and continuing up to the present time. He died at an early age, but he had stamped his ability and force of character upon the mechanical engineering of his age. His widow carried on the business up to a recent date, the management being for the past eleven years in charge of George Ward Fuller, to whom much credit is due for the successful introduction of the Cameron pump throughout the world. Mr. Fuller continues as vice-president and general manager of the company; George Doubleday, who is first vice-president of the Ingersoll-Rand Company, being president, and the direc-

torate being composed of Mr. Fuller and the directors of the Ingersoll-Rand Company.

Motor Driven Crank Shaper.

THE accompanying illustration shows a new motor driven crank shaper with speed box, made by the John Steptoe Shaper Co., Jessamine Station, Cincinnati, Ohio. The drive consists of a small gear on the motor with a large gear on the speed box shaft. Four changes of speed are secured through the speed box, and by means of the back gears, eight changes are secured.



The machine can be stopped or started by means of a clutch which operates in the hub of the large gear. One pound pressure on the clutch lever gives 128 pounds pressure on the ring, so that the machine can be started or stopped almost without effort on the part of the operator. It can be operated by means of the thumb and first finger of the right hand. All of the clutch mechanism is fully enclosed, thus avoiding the possibility of the operator getting caught, and doing away with the possibility of accidents.

All the bearings in the speed box are equipped with ring oilers, which keep the shafts constantly flooded in oil. Spiral oil channels are chased in the shaft to insure the proper distribution of the oil

over the entire bearing. The speed box is so arranged that no clutches are used, and there are, therefore, no gears running idle on the shaft, avoiding any possibility of noise or wear on the hole in the gears. When one gear is shifted in position, the other is shifted out, thereby making a very effective drive, and reducing the wear to a minimum. The only wear on our gears is when they are in actual operation, and all gears are keyed to the shaft.

The motor used is a General Electric 3 horse power, constant speed, running about 1,200 revolutions per minute.

A large bush is provided where the driving shaft from the shaper enters the speed box. This bush enters the column of the shaper and also the speed box bearing. The driving shaft is therefore relieved of any possible strain that might come from the speed box, as such strain would come directly on the bush provided for that purpose. This bushing is provided with ring oilers both in the column of the shaper and in the speed box. The intermediate shaft in the shaper is also provided with ring oilers and bushings, which can be readily removed and replaced at any time should it become necessary. The speed box is supported by means of a heavy brace, projecting from the base of the shaper.

This drive is so simply constructed, that there is nothing on it which can get out of order. The motor is set on a subbase, which is cast onto the base of the shaper. The motor is therefore set on a very solid foundation, and avoids the possibility of shaking the machine when running, thereby preventing chatter marks on the work which is being planed.

A Large Pumping Contract.

ONE of the largest contracts for pumping machinery ever placed has been awarded to the Alberger Pump Company of New York City by the Bureau of Yards and Docks, the total sum involved being slightly over $323,000. The contract covers pumping equipment for the three new dry docks to be constructed by the Government at New York, Puget Sound and Pearl Harbor Navy Yards, and include all told eleven 54 inch vertical volute pumps, each direct connected to a 550 horse power induction motor, and seven 15 inch vertical volute drainage pumps, each direct connected to an 85 horse power induction motor; also all necessary suction and discharge piping, electrically operated gate valves for the same and all electrical controling apparatus for the motors. Three of the 54 inch units will be located at New York, while four of these units are required for each of the other docks.

Each unit is required to operate against a static head, varying from zero when the dock is full to a maximum of 42 to 44 feet when the dock is completely empty, while operating at a constant speed of 219 revolution per minute without exceeding the rated horse power of the motor at any point. In addition to this each pump is required to maintain an average capacity of 66,000 gallons per minute when emptying the dock from approximately mean high water to one foot above the elevation of the keel blocks, the static head varying from zero to 32 or 34 feet. Under these conditions the contractor has guaranteed an average efficiency of 45 per cent. for New York and Pearl Harbor and 46 per cent. for Puget Sound, these efficiencies being the ratio of the actual useful work in pumping the docks to the electrical input to the motors, and consequently include all losses in the motors, pumps and piping. To meet these average efficiencies it is necessary for the pumps, themselves, to each a maximum efficiency of nearly 80 per cent.

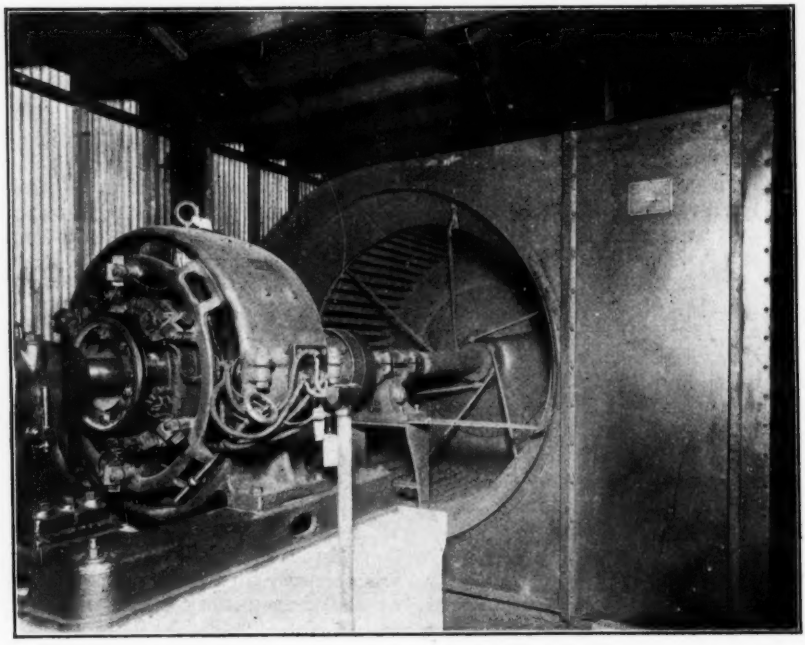
In addition to obtaining a high efficiency, the other characteristics of the pump have to be very carefully determined in order to meet the special conditions involved in this class of work. In fact but few concerns in this country are equipped with the necessary engineering data and experience to undertake work of this character.

Tunnel Ventilation.

ABOUT two months ago, the Hudson & Manhattan Railroad installed at their Washington street power house, Jersey City, N. J., a large double inlet "Sirocco," full housed exhaust fan, for the ventilation of the Hudson Tunnels in that vicinity. An illustration of the outfit is given above.

This apparatus consists of a No. 13 double inlet "Sirocco" full housed fan, with blast wheel 78 inches in diameter by 78 inches wide at periphery, containing 64 blades. Direct attached to the fan shaft by means of a flexible flanged coupling, is a 40 horse power Sprague, slow speed type motor, wound for 600 volts, direct current. Normal speed 175 revolutions per minute, maximum speed 200 revolutions per minute.

The outfit was erected in an air-tight room, the air being exhausted from the tunnels through air-ways and shaft provided for the purpose. There are no connections or ducts between the fan inlets and the air shafts, the air velocity being produced by the suction head maintained in the fan room.

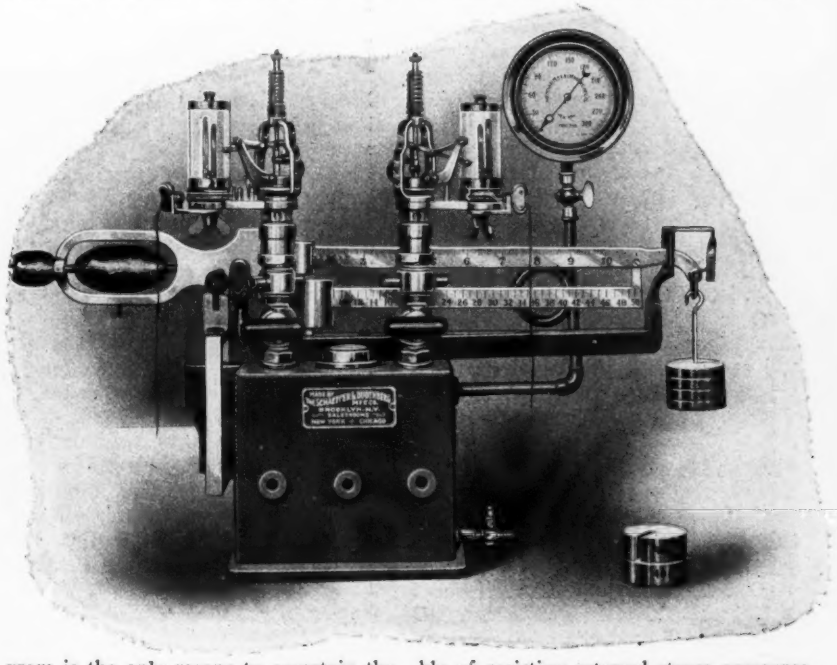


The fan discharges through an evase stack having a screened outlet hood, similar to those used on mine ventilating fans. The fan was required to exhaust from the tunnels 6,000,000 cubic feet per hour, or 100,000 cubic feet per minute.

Determining the Accuracy of Indicator Springs.

THE indicator is unquestionably the most necessary instrument for the operating engineer. The indicator diagram is the only means to ascertain the action of the steam in the engine cylinder, to determine the efficiency of an engine, and to detect internal wastes. It is, therefore, of vital importance that the indicator be absolutely accurate in its performance, which applies especially to the piston spring, the most essential part of the indicator, unless the exact tension of the spring is known errors will result from its use, and the determinations made with the indicator will be of little or no value. The need for a reliable instrument for testing indicator springs has been filled with the apparatus illustrated herewith.

This apparatus, which is made by the Schaeffer & Budenberg Mfg. Co. of Brooklyn, N. Y., consists essentially of a closed vessel made of cast iron, capable of resisting internal steam pressures up to 200 pounds per square inch. The steam pressure in the vessel is measured by a gauge of special construction consisting of a piston of one-half square inch area and which is free to move in an inclosing cylinder.



The lower portion of the piston is

pointed and rests in a yoke which is suspended on the knife-edge of a pair of scales mounted on top of the closed vessel. If the scales are previously balanced, before admitting steam into the vessel, it is evident that the reading of the scales will give the pressure acting on each element of the vessel equal in area to that of the piston. The scales are graduated to fiftieths of a pound which permits of very close readings.

In testing indicator springs steam is turned into the vessel to gradually warm it and allowed to blow through the connections and indicator cocks to remove any particles of dust or grit which may have accumulated there. Shut off steam again and screw indicator in its place putting paper on the indicator drum, n which paper two vertical lines are ruled.

Press the indicator pencil against the drum and draw a horizontal line at the point thus marked. Then set the poise of the scale at say 5 pounds and admit steam into the vessel gradually rising in pressure until the scale floats. When the pressure is exact draw the line R R and so on for successive pressures of 5 pounds, until the limit of the scale is reached. During this operation the motion of the indicator pencil is continuously kept upward, if at any moment the pressure rises too high, it is lowered by manipulating the valves below the required amount and then gradually raising to the desired point.

When the indicator pencil has reached its highest position, the steam pressure is allowed to fall gradually and a series of similar lines, as W-W, X-X, Y-Y and Z-Z drawn during the descent of the piston. The motion being continuously downward. The distance between any two of these lines as Y-R, Y-S, indicates the loss due to friction of the indicator.

The special advantage of this machine, besides its absolute accuracy, is that the indicator springs are tested in the individual indicator in which they are used and under actual steam pressure which is as near to the actual working conditions as possible. The indicator spring testing apparatus serves also for testing pressure gauges, which can be connected to the three openings in the front side of the vessel provided for that purpose, and the readings are verified by the indications on the scales and the test gauge shown in the illustration.

Sebco Mooring Bolt.

THE Sebco mooring bolts have been adopted by the Department of Docks and Ferries of New York City as the standard bolt for construction work in concrete. These bolts are specially devised for concrete construction. With the new way the Sebco mooring bolt is moulded in the concrete just where it is wanted. The bolts will not bend and the threads will not strip. You get the full strength of the bolt and can renew the bolt with any length desired at any time without redrilling holes. This new method saves the workman's time and labor and there is no loss of material.

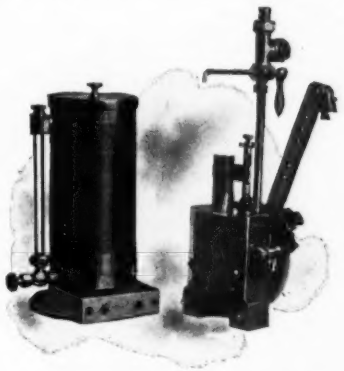
The Sebco mooring bolt is manufactured by the Star Expansion Bolt Co., of No. 147 Cedar street, New York City, who will gladly send full information and descriptive matter of this and other Sebco products illustrated in their catalogue to anyone addressing Catalogue Department 56.

Rochester Lubricator.

THE Rochester automatic lubricator is the pioneer in the force feed lubricator field. Its popularity is due to the following reasons:

It is absolutely positive, due to the fact that there is always under pressure a solid column of oil from the lubricator to the point of delivery; it will pump

against very high pressures even up to 1,500 pounds and over; due to the positive pump, the temperature makes absolutely no difference, as the same amount of oil will be pumped regardless of whether it is thick or thin; by means of three distinctly different methods of regulation, the amount of oil fed can be regulated so that the lubricator will feed anywhere from the smallest fraction of a drop to an almost continuous stream; the pump block is detachable making it



easy to clean or repair the lubricator; there is a double set of ball valves that prevent the clogging of the lubricator, each feed of every lubricator from the one-pint size up is provided with a patent combination multiplus sight feed and three-way cock; all lubricators from the one-pint size up are fully nickel-plated, and because of their appearance are an addition to any engine room; the lubricators are made in all sizes from one-pint to two-gallon and with any number of feeds from one to eight; by their use there is a great saving of oil, time and labor.

The manufacturers, Greene, Tweed & Co., 109 Duane street, New York, will be glad to furnish a complete catalogue to any interested inquirer.

Large Grinding Wheel.

WHAT is believed to be the largest vitrified grinding wheel ever made was recently turned out at the works of the Carborundum Company, Niagara Falls, N. Y. The wheel in question is made of Aloxite, the new steel grinding abrasive recently put on the market by the Carborundum Company. The big wheel is 48 inches in diameter and is to be used for tool grinding by one of the Carborundum customers in France.

Industrial Notes.

—The Stephens-Adamson Mfg. Co., Aurora, Ill., has recently strengthened their organization by securing the services of G. H. Stephens. Mr. Stephens has obtained substantial interests in this company, and has assumed the management of their entire eastern business. The eastern office is at 50 Church Street, New York City. Mr. Stephens has been a prominent factor in the conveying industry for over twenty years. He has a comprehensive knowledge of conveying and screening machinery and a wide acquaintance among the machinery users of the East. The Engineering Department of the New York office is under the charge of J. G. Macrum. Mr. Macrum was formerly associated with Mr. Stephens in business and is recognized as a conveying engineer of ability. Earl D. Stearns, who has ably represented the Stephens-Adamson Co., in the East for the past two years, has taken charge of the company's Chicago office in the First National Bank Building. The Stephens-Adamson Mfg. Co. are manufacturers of a complete line of conveying, elevating, screening and power transmitting machinery. Their main office and shops are at Aurora, Ill.

—H. M. Byllesby & Company of Chicago has acquired control of a number of additional public utility properties in California, including two important

water power developments and several water power sites not yet developed. The principal local plants purchased consist of the electric and gas properties formerly owned by the Stockton Gas and Electric Corporation, at Stockton; the electric light and power business at Richmond and the gas and electirc properties at Eureka. The American River Electric Company, which owns a large hydro-electric plant on the American River in Eldorado County, California, and maintains a reserve steam turbine plant at Stockton, is included in the transaction. The Humboldt Gas & Electric Company, operating at Eureka, possesses a considerable water power development in Trinity County, transmitting current to Eureka, 65 miles distant. The American River Electric Company's business includes service to Stockton, Placerville, Florin, Elk Grove, Sheldon, Gault, Lodi and Plymouth by means of long distance transmission lines, which are also extensively utilized for supplying power for gold mining and irirgation purposes. The Humboldt electric business includes service to the towns of Arcata, Alton, Ferndale, Fields Landing, Fortune, Hydesville, Loleta and Rohnersville. Eureka and surrounding towns have a population of 22,000. They are on Humboldt Bay which affords one of the few good harbors on the Pacific Coast. Back of the city lies an immense area of redwood forests. Eureka will soon be connected with San Francisco by a railroad line now under construction. Stockton with suburbs has a population of 30,000, is one of the oldest cities in California and is a manufacturing center of importance. Richmond, a newer town of 12,000 people, lies on San Francisco Bay south of Berkeley. It, also, is a manufacturing center and is the location of large new shops being built by the Pullman Car Company. All three cities have shown wonderful recent growth. A new company known as the Western States Gas and Electric Company, has been formed to hold the stock of the properties described.

—The firm of Dodge, Day & Zimmerman of Philadelphia, have added to their organization Walter Loring Webb and James M. Kennedy, well known in the engineering world. Mr. Webb is the author of several engineering textbooks, including "The American Civil Engineers' Pocket Book," "Economics of Railroad Construction" and "Problems in the Use and Adjustment of Engineering Instruments."

Obituary.

Louis R. Alberger, president of the Alberger Condenser Company and the Alberger Pump Company, 90 West Street, New York, died January 31. Mr. Alberger was one of the best known specialists in the country on pumping machinery and condensing apparatus. After attending Yale University he went in business with his father, who was engaged in the manufacture of vacuum process specialties used in the salt industry. In 1887 Mr. Alberger became connected with the Henry R. Worthington plant, afterward a part of the International Steam Pump Company. He left the Worthington organization in 1901, when he formed the Alberger Condenser Company and acquired the plant of the Newburgh Engine & Ice Machine Co. at Newburgh. Shortly afterward he formed the Alberger Pump Company.

George Q. Palmer, formerly vice-president, has been made president of the Alberger Condenser Company, and the Alberger Pump Company. Mr. Palmer is succeeded as vice-president in the Alberger Condenser Company by D. H. Chester, and in the Alberger Pump Company by W. S. Doran.

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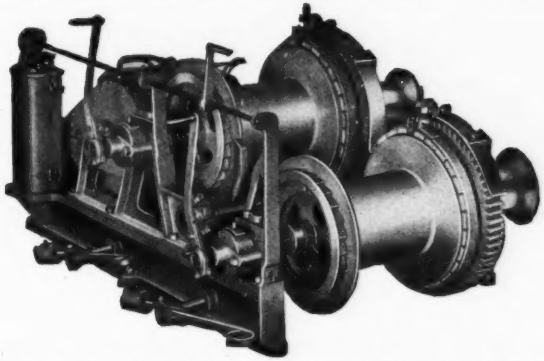

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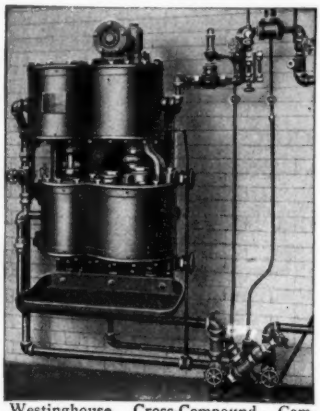

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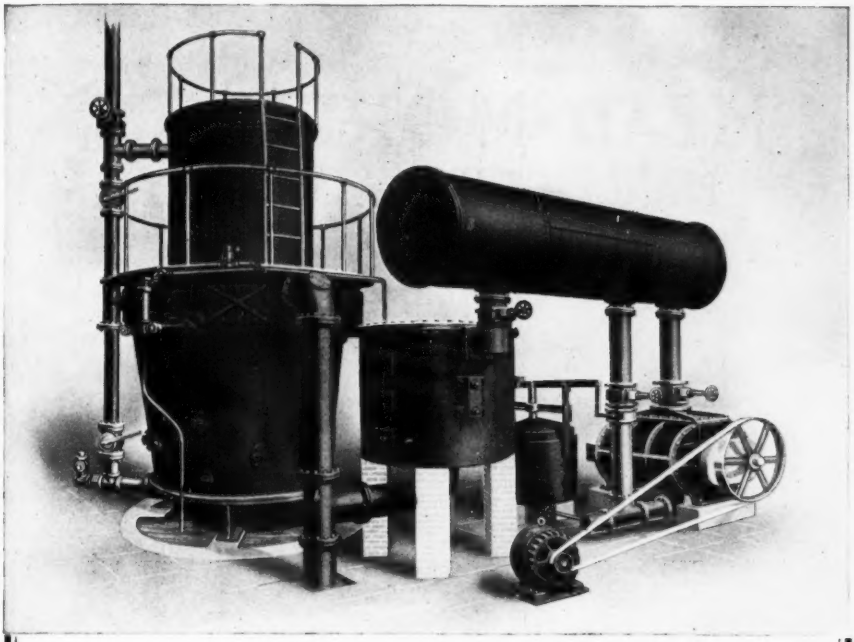

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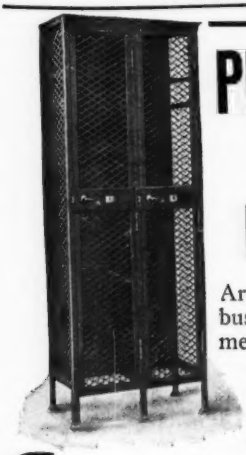

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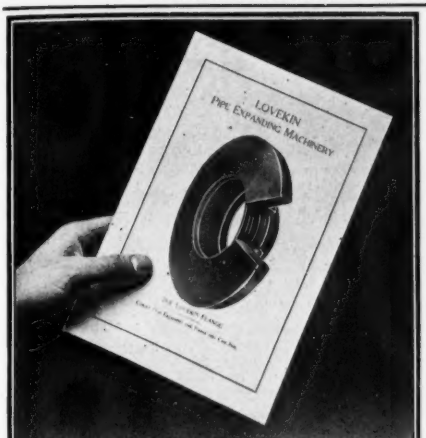

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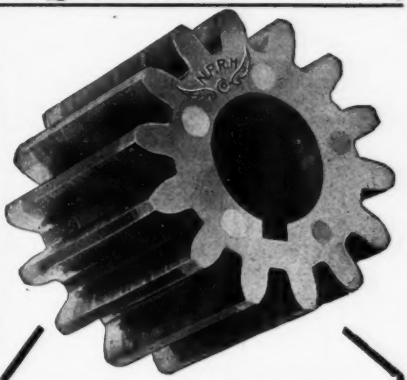

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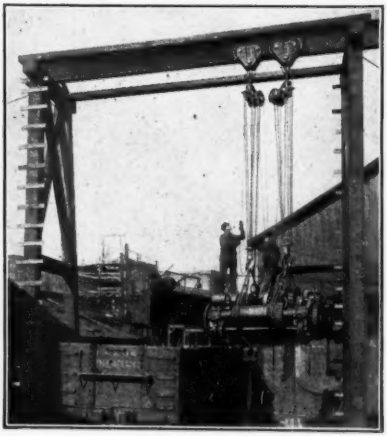

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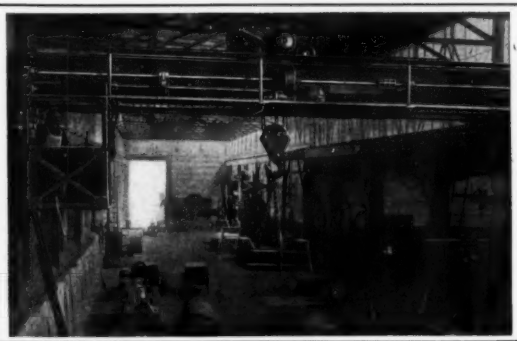

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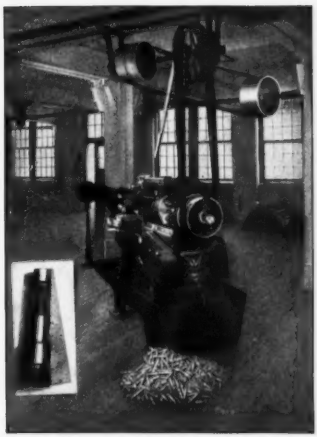

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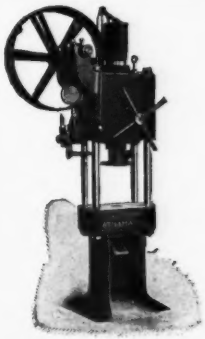

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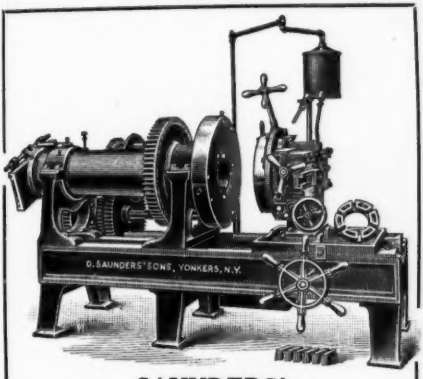

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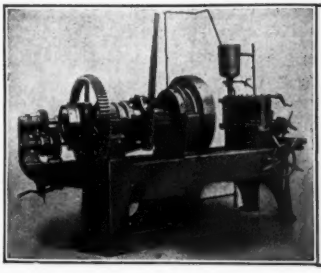

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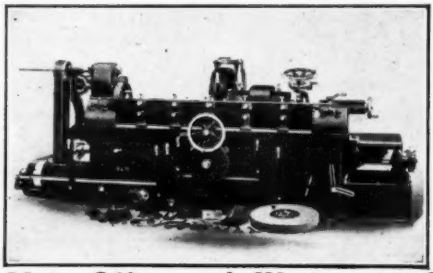

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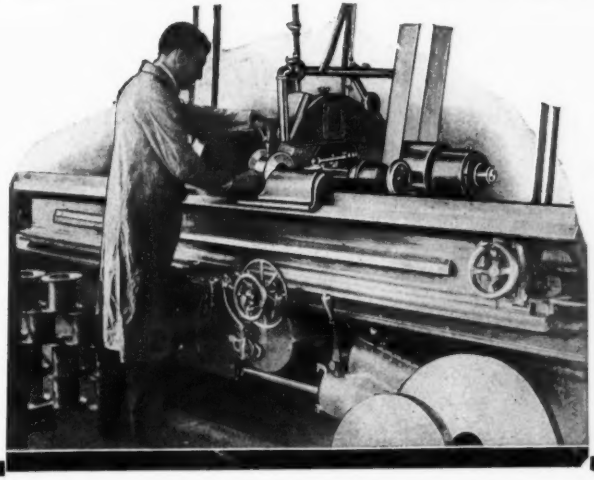

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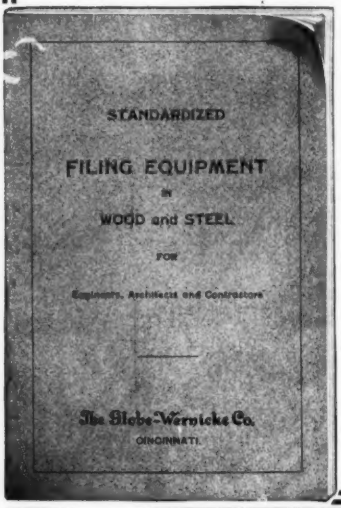

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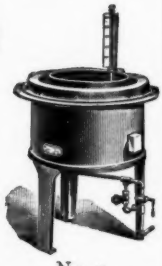

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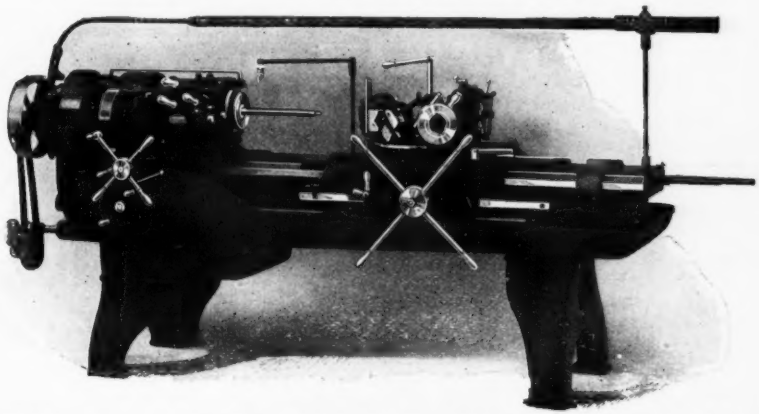

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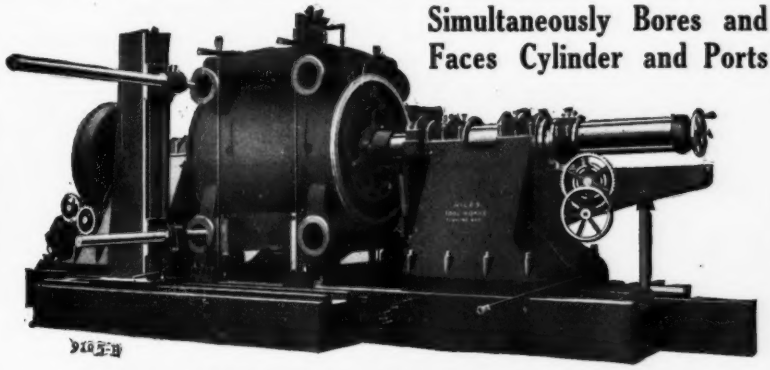

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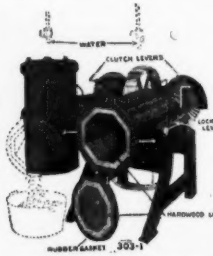

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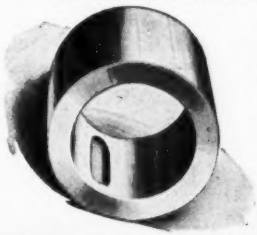

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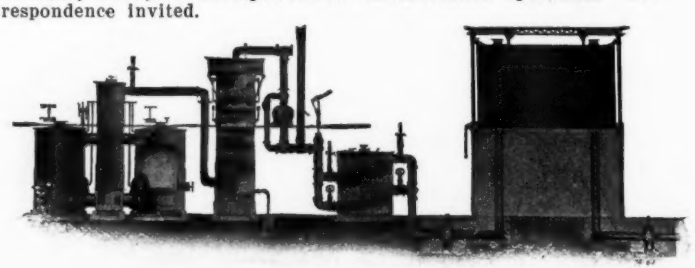

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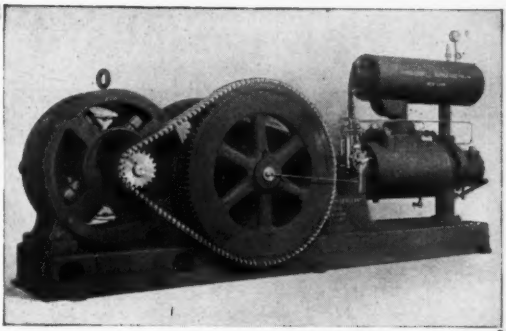

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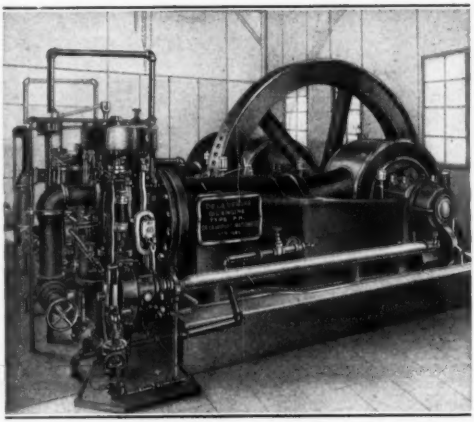

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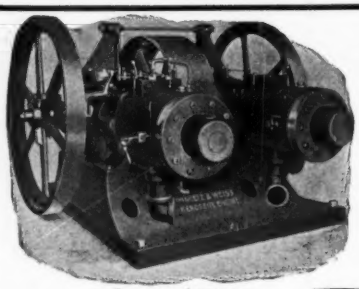

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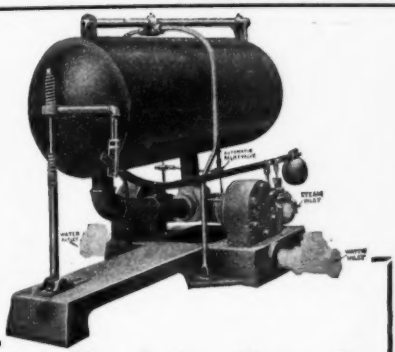

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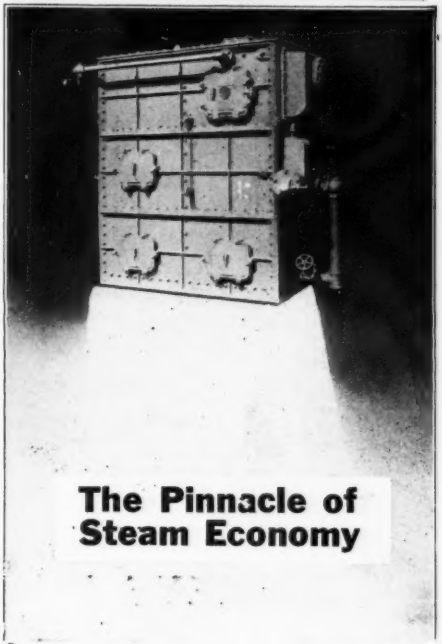

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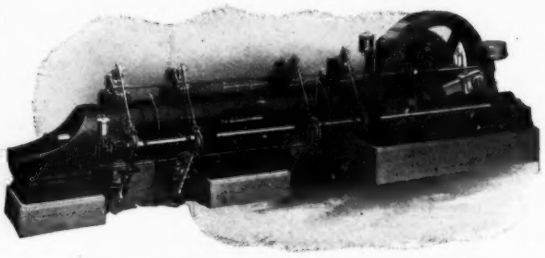

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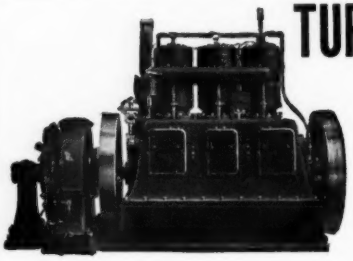

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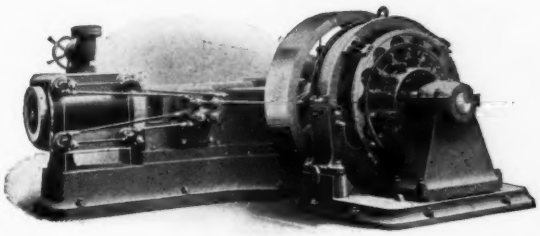

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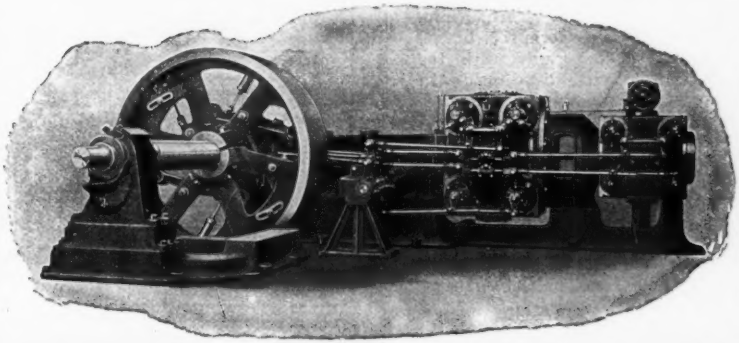

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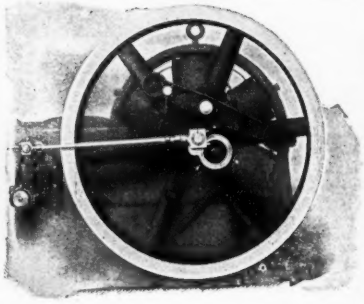

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American Engine Co.

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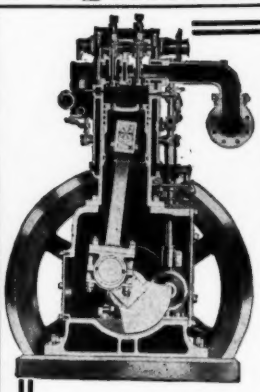
BOUND BROOK, N. J. 49



Economy in Motive Power

is most surely obtained by the installation of Bruce-Macbeth Gas Engines.

They will develop their full rated horsepower evenly and continuously on a minimum of fuel consumption; and are reliable, safe and positive in operation. They take up very little floor space, and are always accessible for cleaning and adjusting without dismantling. Operates on Natural, Artificial and Producer Gas.

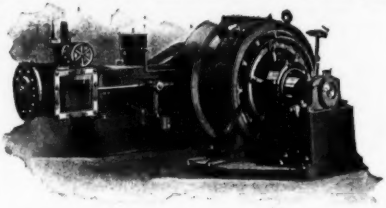
Our Catalogue takes each part separately, and tells how we reduce wear to a minimum and how the complete unit figures effectively in reducing manufacturing costs.

The Bruce-Macbeth Engine Co.

Cleveland, Ohio

2103 Center St., N. W.

BALL ENGINES



We commenced building Engines for Electrical power service in 1882. We have concentrated our efforts towards building the best possible engines ever since. We have the experience, the works and the workmen, and the engineering force to make them right. Our Single-Valve Automatic Engines and High-Speed Corliss Engines with Patented Non-Detaching Valve Gear excel in economy and reliability.

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ANTI-CORROSIVE CYLINDER OIL MANUFACTURED ONLY BY W. K. KELLOGG & SON

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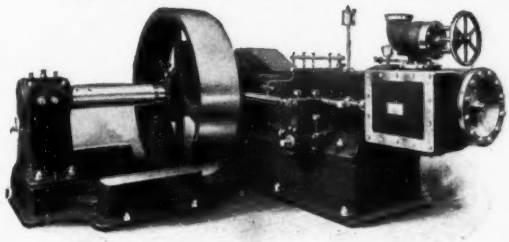


9000 in operation

o listed for sale by second-hand dealers.

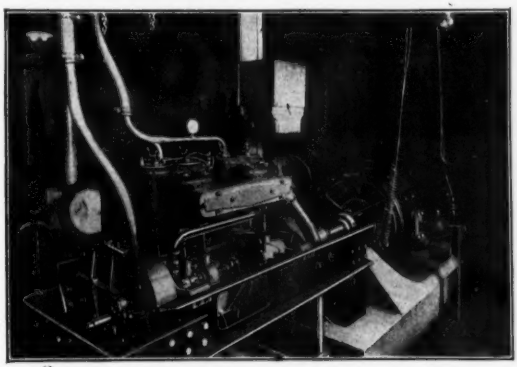
36 years ago the first Skinner engine was started and it is still runing

If your grandfather did not use a Skinner, see that your grandson does by ordering one for yourself.

SKINNER ENGINE CO., Erie, Pa. Branch Offices in 21 cities.

ENGINE TESTING

EASY QUICK ACCURATE EFFICIENT



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SPRAGUE ELECTRIC DYNAMOMETER

Will test any type of engine, turbine, pump or tool. Specially trained men are unnecessary. No smoke, heat, noise or danger.

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DAMPER REGULATOR

It is positive in action, simple, readily adjusted and easily cleaned. It will close the damper promptly to prevent over pressure on the boiler and open it quickly when a hurry call for more steam is made.

This device will save from 10 to 15 per cent of fuel over the old style diaphragm and lever regulator.

Send for circular and learn how we are able to accomplish these savings and why we guarantee results.

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LEATHER PACKINGS

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The cutting and shaping is done by "men who know"; the combined result being a Perfect Leather Packing which for all around goodness and as a trouble saver cannot be excelled.

A sample and a descriptive booklet will be sent you at your request. Write for them today.

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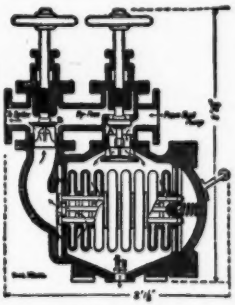
Standard Recording Thermometers are necessary adjuncts to the successful operation of every heating and ventilating installation.
Send for printed matter containing sizes, styles and prices.

Standard Thermometer Co.
Boston, Mass.

Keep Out Oil.



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It is extensively used both on land and sea.

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It is free to any engineer, power plant manager, superintendent or owner who will write for it.

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You may send your new General Catalogue to the following address:

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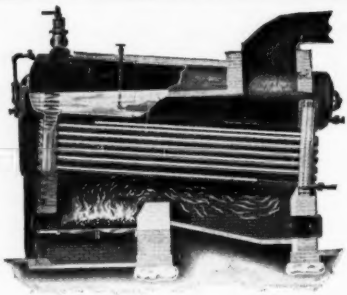

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BOILER

BUILT BY
FRANKLIN BOILER WORKS CO.
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GENERAL SALES OFFICE
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THE BABCOCK & WILCOX COMPANY
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STEAM SUPERHEATERS MECHANICAL STOKERS

Works: BARBERTON, OHIO BAYONNE, N. J.

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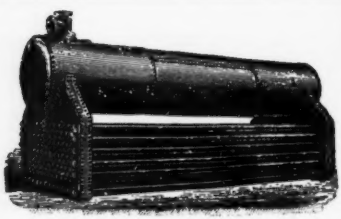

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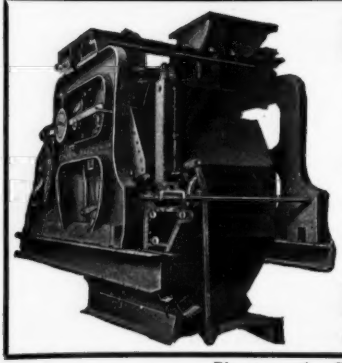
THE ORIGINAL OF THIS ALL STEEL TYPE OF CONSTRUCTION MANUFACTURED ONLY BY THE
HEINE SAFETY BOILER CO. ST. LOUIS, MO. U.S.A.



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For weighing run-of-mine coal from cars or barges.
For checking coal consumption of automatic stokers.
For weighing in coal from the sidewalk.

These machines furnish a perfect check on all coal received at power station, factory, or hotel.

Installed under overhead bunkers, they check the coal consumption of boilers and prevent carelessness in firing.

They will weigh uncrushed and wet coal without stopping.

Many installations—All satisfied.

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If you have some difficult proposition and can't see your way out, let US solve it for you.

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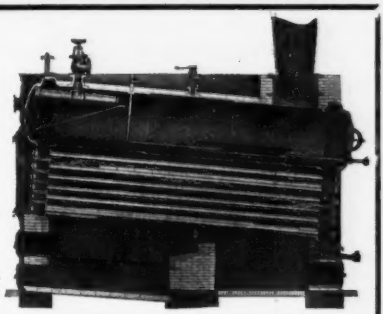
Wilkinson Safety Water Tube Boiler

Patented

All flange steel construction—Great responsiveness to overload demands—Absolutely perfect circulation—Minimum setting space—Durability of parts—Equal expansion—Dry steam—Economy.

The above features commend the Wilkinson Boiler to all steam users. Write for Bulletins Nos. 1451 and 1471.



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Executive Offices:
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Boiler Dept., Oswego, N.Y.
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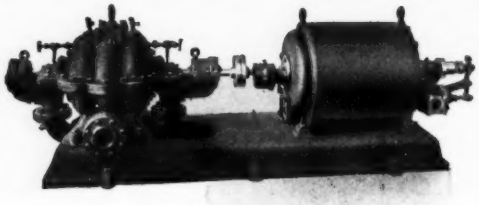
In its Fidelity, Boiler, Elevator, and Fly-Wheel lines careful inspections are made by experts

ASSETS	$9,698,924.02
CAPITAL AND SURPLUS	3,564,229.90

YOU WOULD LIKE THIS KERR TURBINE-DRIVEN BOILER FEED PUMP



Centrifugal boiler feed pumps deliver comparatively high pressures and run at rotative speeds favorable to the economical working of the turbine.

The turbine is simplicity itself compared to any single or duplex reciprocating pump — smaller, no unbalanced parts, fewer places to use oil and waste, no adjustable parts to get out of order, no close fitting parts inside where wear can increase the useless consumption of steam, and it is always ready to start on short notice. There is no clicking noise, no vibration to necessitate a heavy foundation, and above all *no oil gets into the exhaust steam.* The exhaust can be used for preheating the feed without decreasing the efficiency of the closed heater, or the condensation can be sent back through an open heater without getting any oil onto the boiler heating surfaces.

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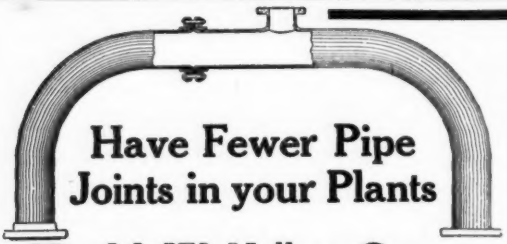
Agents in all large cities **Wellsville, New York**



Have Fewer Pipe Joints in your Plants

You can do away with a great number of pipe joints by having the pipes welded end to end, and having outlets welded on the piping. It saves you considerable expense, as well as time, labor and trouble.

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Don't buy a Lubricator that will work only under certain conditions, but buy a "Rochester" and end your lubricator troubles.

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EFFICIENCY IN THE MANUFACTURE OF TRANSPORTATION

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It is based on a thorough study, covering all important shop points on the line and aided by every opportunity to get facts, figures and illustrations, from the men's point of view as well as the officials'.

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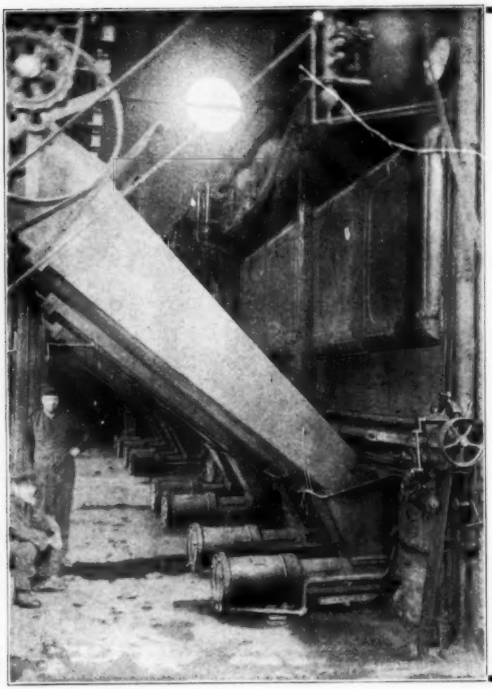

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SANDUSKY PORTLAND CEMENT CO.,
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This company states that by the use of

JONES STOKERS

They have saved enough (over hand-fired results) to pay for the entire equipment (including overhead coal tanks)

IN ONE YEAR

Their coal consumption is reduced 10 tons daily.
Their labor cost is reduced 33%.
Their steam pressure is uniform.
They have placed additional orders.
Ask them.

The Under-Feed Stoker Company of America,
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For High Rates of Combustion

70 Pounds of Coal per square foot per hour can be burned by a

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This type can burn more coal than any other, simply because it cleans the fire automatically and disposes of the refuse economically.

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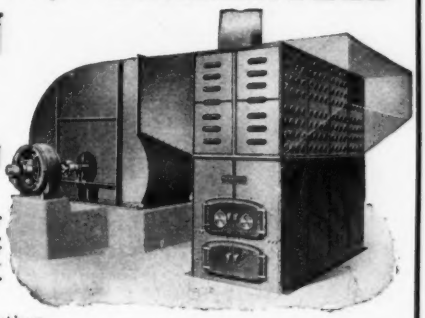

Being the latest modern improvement for adaptation in factories, shops, hospitals, schools, churches, loft buildings, garages, car barns, bank buildings, office buildings, theatres, residences, etc., etc. **Some decided advantages:—**

Much lower first cost.
Positive ventilation combined with heating.
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No licensed engineer required.
Absolute safety—cannot freeze up or explode.
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For absolute control of all kinds of heat —measurements up to 1,600 deg. Celsius or 2,920 degrees Fahrenheit. EXACT, DURABLE, Easy to Understand and to Handle.

HERAEUS PATENTED ELECTRICAL FURNACES for LABORATORY AND EXPERIMENTAL USE.

FUSED SILICA WARE OF EVERY DESCRIPTION AT MODERATE PRICES.

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This Heraeus Patented Fused Quartz Glass is not affected by any changes of temperature, whatsoever, and the coefficient of expansion is only 1-17 that of platinum.

It is of the utmost importance for all purposes where the above qualities are essential.

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It describes and lists

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Write for a copy of this book, No. 134 EG, giving details of your conditions, and our engineers will be pleased to suggest the most suitable layout and to quote you discounts from the list prices given.

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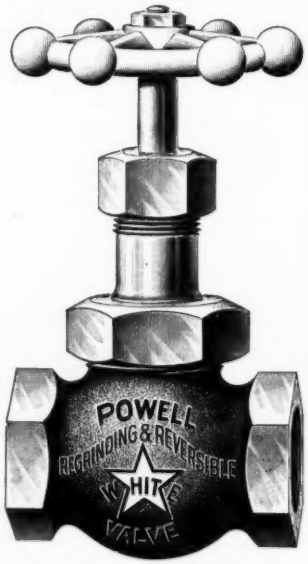
Engineers; Builders of Green's Fuel Economizers, Fans, Blowers and Exhausters, Steam Air-Heater Coils, Waste Heat Air Heaters, Mechanical Draft, Heating and Ventilating and Drying Apparatus, Draft Dampers and Engines.
295

THE POWELL WHITE STAR VALVE

REVERSIBLE REGRINDABLE RENEWABLE



The Reversible and Renewable Features alone make the Powell WHITE STAR Valve unusually valuable for all power service. When one side of the disc is worn out reverse it. When both sides of the disc are worn out throw the disc away and not the valve—you can buy a new disc, you don't need a new valve. This new disc can be inserted in the holder in ten minutes.

This feature is not possible with the ordinary regrinding valve, when the disc wears out you must throw the valve away.

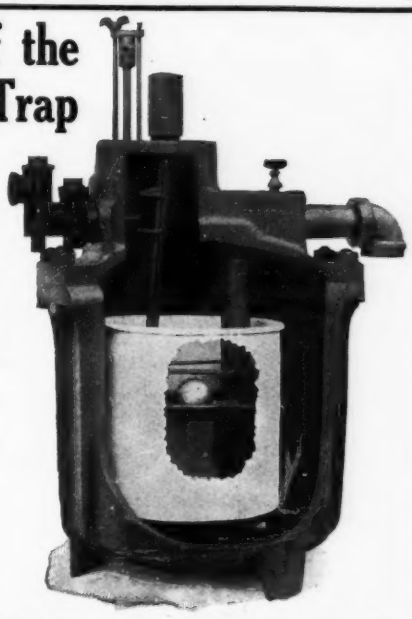
The cost of a disc is a few cents.

The cost of a new valve is dollars.

Figure the difference and see your advantage. All dealers have them or can get them for you. Look for WHITE STAR on the body.

THE WM POWELL CO.
DEPENDABLE ENGINEERING SPECIALTIES
CINCINNATI OHIO

40 Years' Success of the Albany Return Steam Trap



Means 40 years of money saving to power plant operators.

In that time the "Albany" has drained tons of water of condensation from steam lines and returned it to the boilers again and again at temperatures ranging from 212 to 380 degrees without the aid of pumps or steam loops.

The "Albany" owes its success to its simplicity and the correct principles involved in its design.

All steam valves and devices actuating them are enclosed wholly in the trap itself.

No stuffing boxes to leak or stick.

All joints faced and ground.

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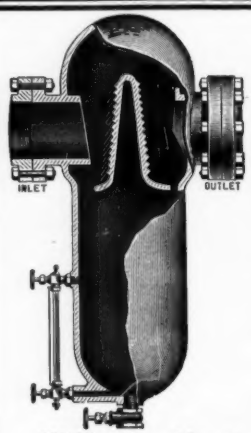
THE ENGINEERING INDEX



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What's the diameter of *your* steam pipe?

The adjustment of baffle plates and areas along scientific lines is the secret of success attained by

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STEAM AND OIL SEPARATORS

For instance

OUR FIGURE "E"
HORIZONTAL IRON RECEIVER STEAM SEPARATOR

illustrated herewith. Note the internal construction arrangement of baffle plates, etc.

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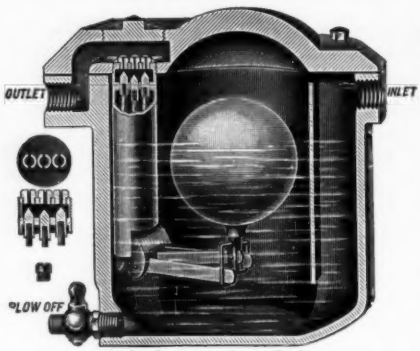

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HIGH PRESSURE CONTINUAL FLOW STEAM TRAP

Used in large numbers by leading power plants the country over.

Three Valves in the WRIGHT TRAP insure perfect and continual discharge of all condensation regardless of small or large flow.

We ship them subject to trial and return at our expense if results are not satisfactory.

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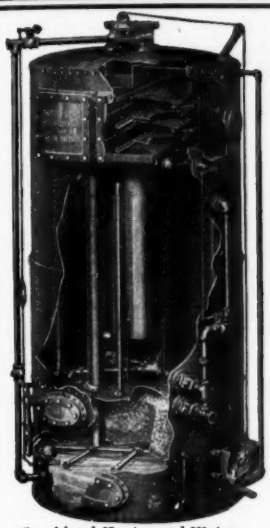

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Effectively removes all oil from exhaust steam.

Removes all scale-forming material possible with exhaust steam.

Guaranteed to soften water so as to cause no scale within boilers.

Guaranteed to remove all suspended matter from the water.

Guaranteed to deliver softened, filtered water at temperature of 204° F. or hotter.

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In point of fact the whole country has been aroused to the importance of the subject, and the reason for it is the enormous amount of publicity that has been given to the freight rate hearings before the Interstate Commerce Commission. The testimony there presented was telegraphed fully each day over the Associated Press wires, the leading daily newspapers of every city in the country began at once to discuss the subject editorially, many of them have published suggestive and helpful special articles, and now the popular magazines are featuring "scientific management" as a subject of widespread popular interest and importance. This is notably true of such widely circulated periodicals as *Collier's Weekly*, *The Saturday Evening Post*, *The Outlook*, *The World's Work* and *The American Magazine*, whose combined circulation reaches millions of readers.

Thus the ideals of Economy in Production and Efficiency in Operation, which for fifteen years past have been the central thought in the work of The Engineering Magazine, have at last gained national acknowledgment. And now that it has taken a place of keenest interest in all engineering, mechanical, and industrial circles, the chief officers of the foremost industrial and transportation companies of the United States are directing and inspiring their subordinates to investigate the subject thoroughly, and to acquaint themselves with the best literature of the new science. In doing this they have turned directly to The Engineering Magazine as the source of exact, abundant, and authoritative information—because the literature of Production Engineering was actually created by this Magazine, and in its most striking expression has been given to the world almost wholly through our pages.

For weeks past, therefore, our offices have been overrun with inquiries, both in person and by mail, thousands of copies of our past publications have been ordered, and from every quarter there comes insistent demand for information upon two main points, viz.:

(1) What are the principles of Efficiency in Management?
(2) How can they be employed in our Works?

To meet this demand for specific information, it gives us pleasure to announce an important special number, to be devoted to SCIENTIFIC MANAGEMENT, and to appear in April, in celebration of the Twentieth Anniversary of The Engineering Magazine.

The definite purposes of this notable publication will be:

(1) To summarize the invaluable work which the Magazine has done in this special field during the past fifteen years;

(2) To list all the standard books of permanent value (published by ourselves and others) on problems of Works Management;

(3) To define, concisely and clearly, the principles of Efficiency, which are Twelve in number;

(4) To show how they can be employed in any given branch of manufacture, production, or operation;

(5) To indicate the character of professional advice that may be needful to the introduction of the new system, or any part of it, to individual works;

(6) To announce, in outline, many invaluable special articles to be published during 1911, showing the practical application of Efficiency principles to the Machine-Shop, the Power-Plant, the Mine, and the Factory;

(7) Finally, to enable every reader to clearly comprehend the present status of the new science, and to plainly mark the steps necessary to the orderly and intelligent employment of all or any part of the system.

Such a publication is certain to prove itself invaluable as a Text-Book upon the subject of Industrial Management—because it will be used by us, and valued by its readers, as a fresh starting-point for study and investigation. And when we consider that in all lines of mechanical industry thousands of thinking men — proprietors, executive officers, engineers, superintendents, and managers—are now studying the subject with reawakened and intent interest, the demand for so timely a publication is made manifest.

Very respectfully,

JOHN R. DUNLAP,

New York, March, 1911. *Editor and Publisher.*

☞ See next page.

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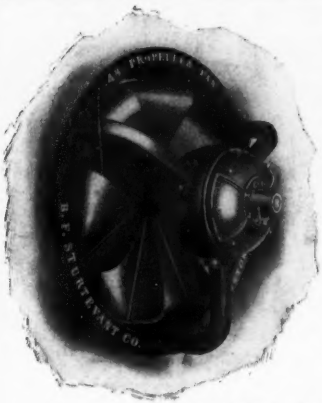

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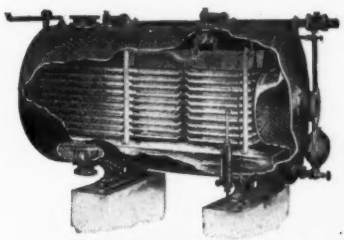

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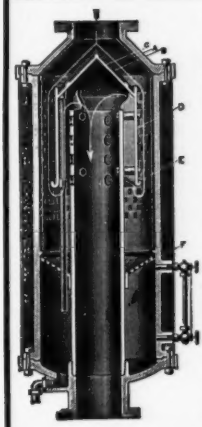

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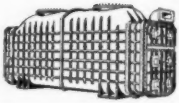

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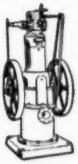

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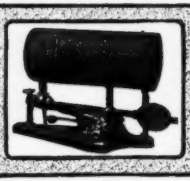

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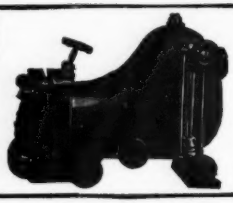

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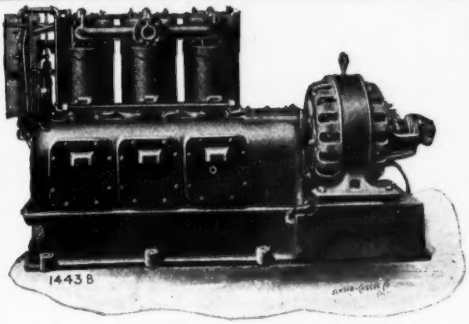

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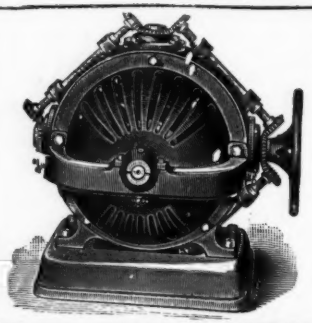

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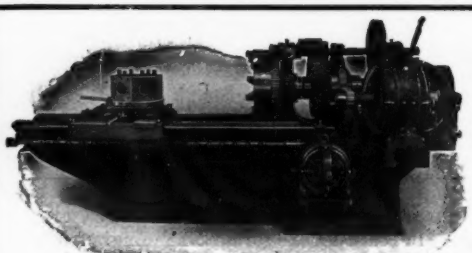

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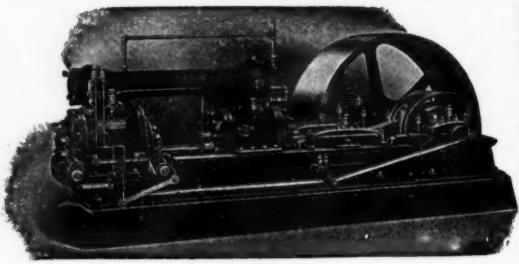

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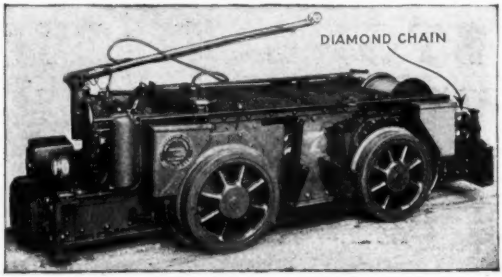

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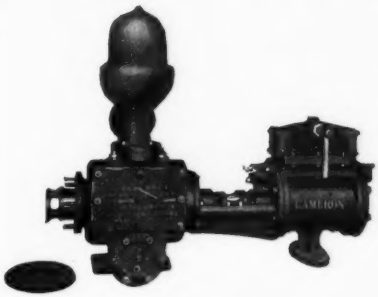

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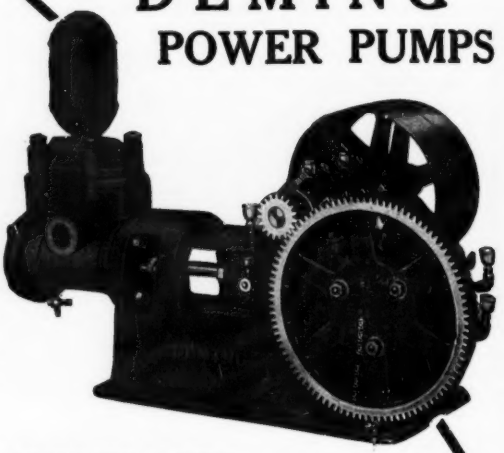

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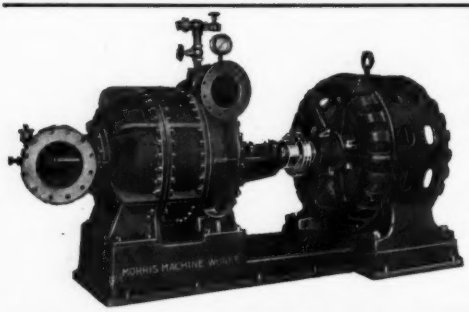

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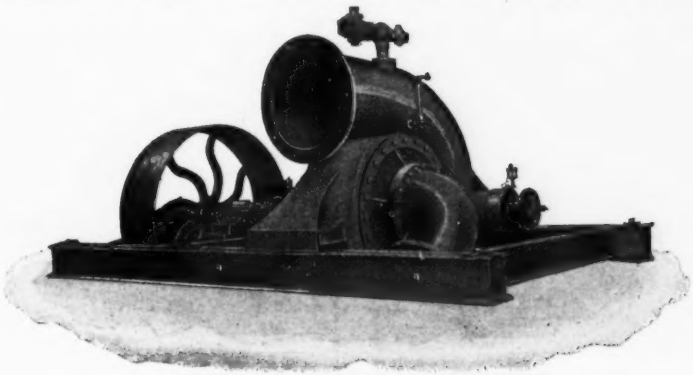

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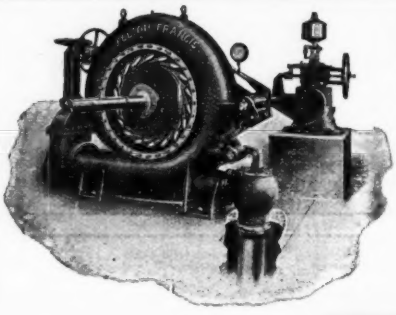

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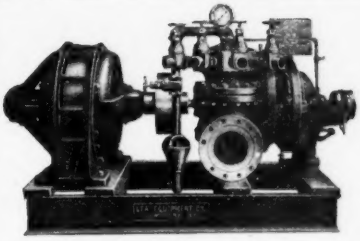

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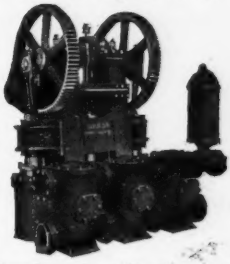

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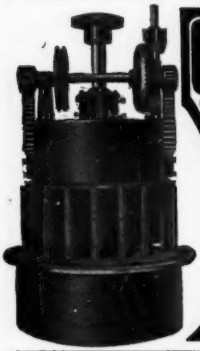

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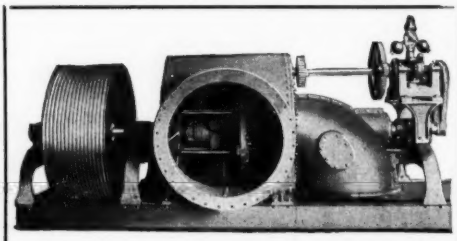

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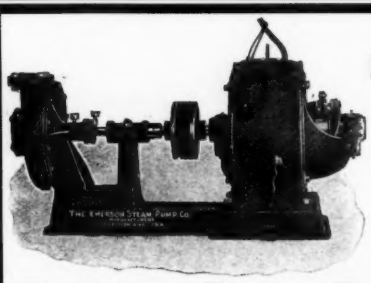

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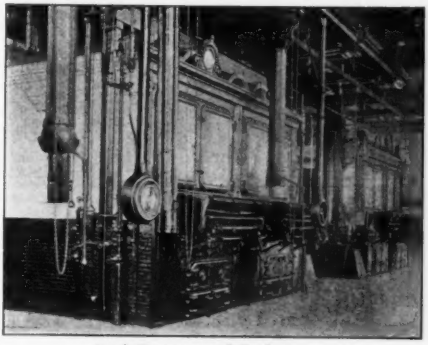

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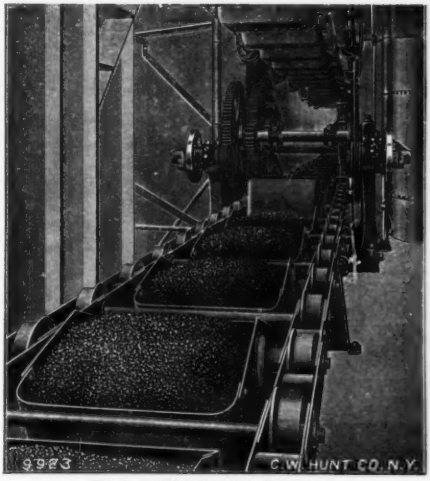

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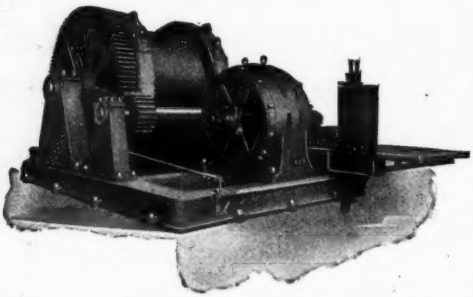

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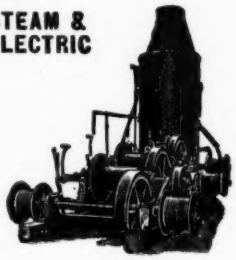

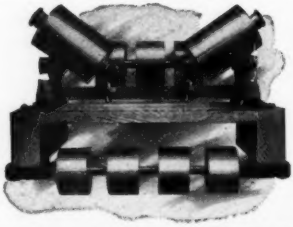

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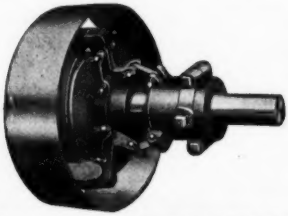

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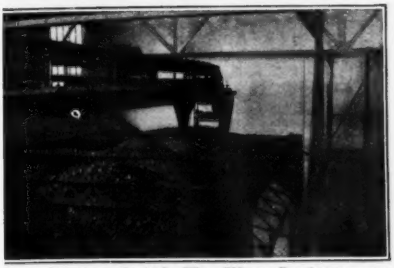

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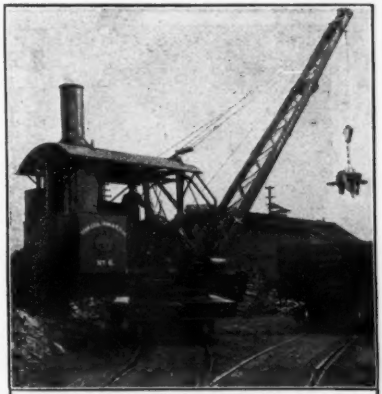

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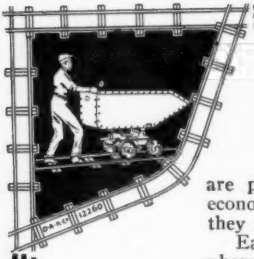

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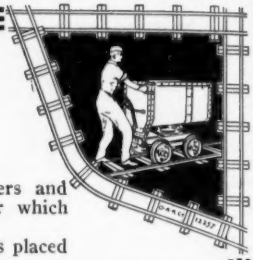

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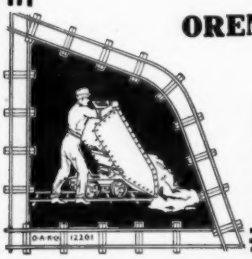

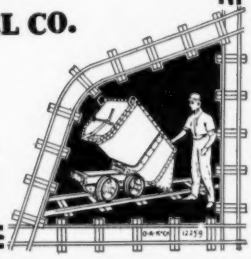

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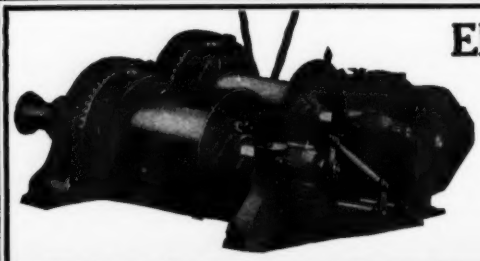

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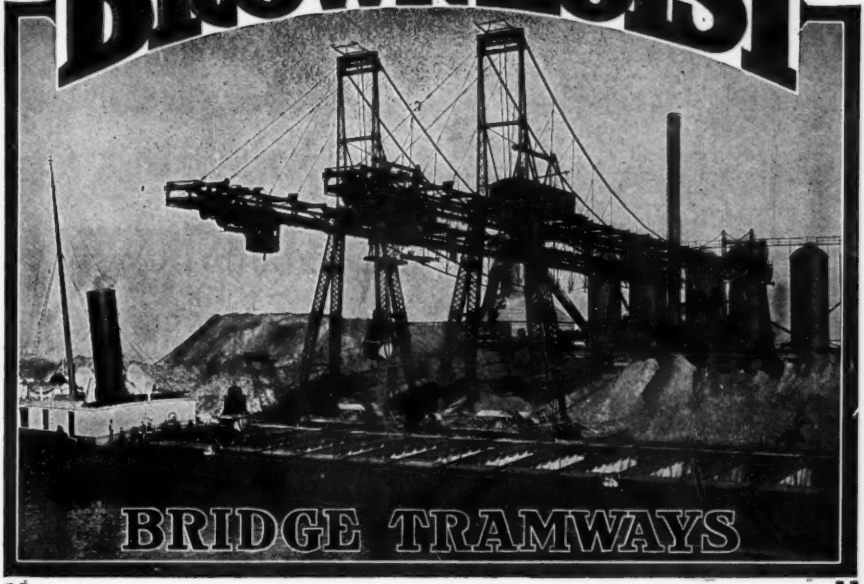

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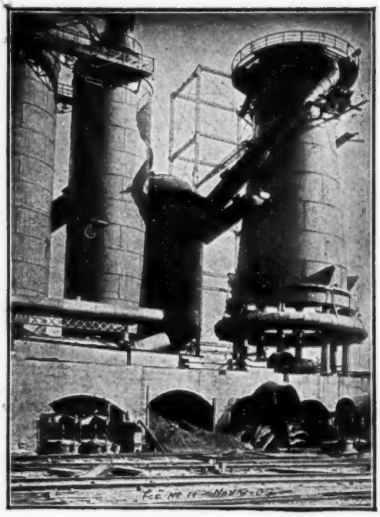

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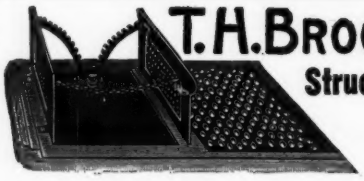

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The Development of the Conveying Belt

FIG 1.

The belt shown in Fig. 1 was used with the first Robins Belt Conveyor at Edison, N. J., in 1891. It was the ordinary rubber belt, no different from that used for transmitting power. It had a thin rubber cover and it wore out quickly as does any belt which has not a thick protecting cover.

FIG. 2

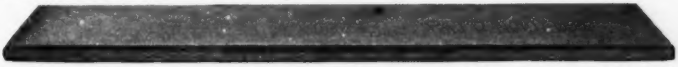
The belt shown in Fig. 2 was used on the second Robins Belt Conveyor, also at Edison, N. J. It had a thick rubber cover on the carrying side and while it lasted many times as long as the first belt, it was found to be somewhat too stiff, and when the middle was worn through, the rubber on the sides was still intact. This construction was therefore not an economical one, and on account of its stiffness, the belt does not run straight except when heavily loaded.

FIG. 3

The belt shown in Fig. 3 was used on the third Robins Belt Conveyor, at Lyon Mountain, N. Y., in 1892. This construction provides for the same expenditure, a belt that will last longer than the belt shown in Fig. 2, but it was found to be too stiff at the centre just where flexibility is required. It did not readily assume the trough form and seemed to prefer to run to one side or the other instead of running straight. It was discarded by the Robins Conveying Belt Co. in 1894, but since its patent expired (on June 13, 1910) it has been taken up and advertised by certain manufacturers who have apparently overlooked its fundamental defects.

FIG. 4

Fig. 4 illustrates an unsuccessful attempt to get around the objectionable stiffness of the belt in Fig. 3, and still to avoid the waste of material. It was found to be structurally weak at points where strength was required. A few of these belts were made in 1894, but none have been made since then by this Company.

FIG. 5 

The belt shown in Fig. 5, which was first made in 1894, was the first real improvement that had been made since No. 2 was produced. It ran straight and well. It "troughs" easily and holds the troughed form between the sets of idlers. It is also economical, allowing the manufacturer to make the best use of both rubber and duck. Extra thickness of duck is supplied at the edges where it is most needed to give strength and firmness, and extra rubber at the centre provides against the extra wear at that point.
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FIG 6.

The latest development in conveying belts consists of the use of one ply of a special open woven fabric on the upper side of the belt. The cover is embedded in the meshes of this cloth and gets such a grip on it that it cannot blister or come loose even when punctured and water-soaked. The cover stays on until it is worn out.

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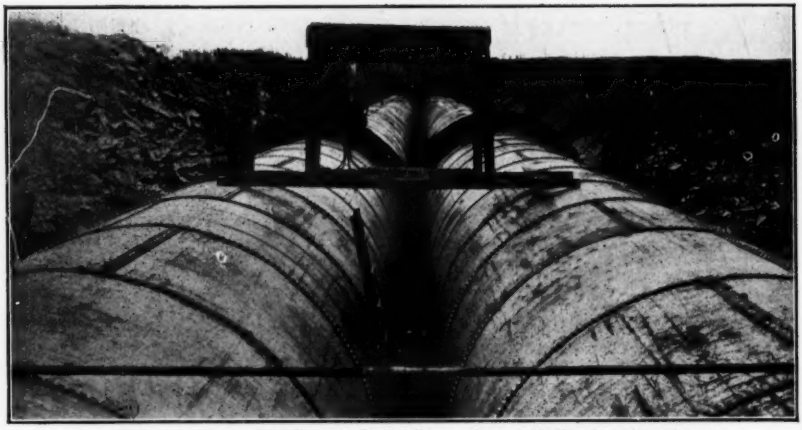

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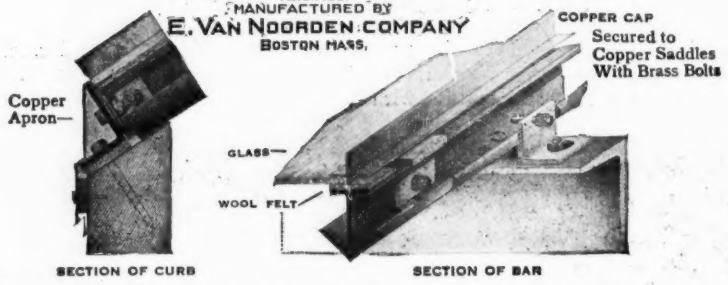

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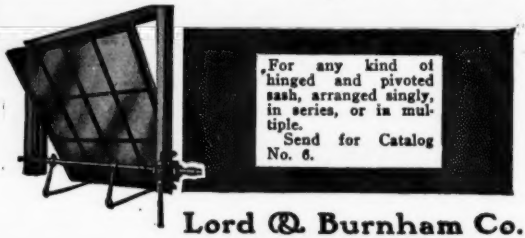

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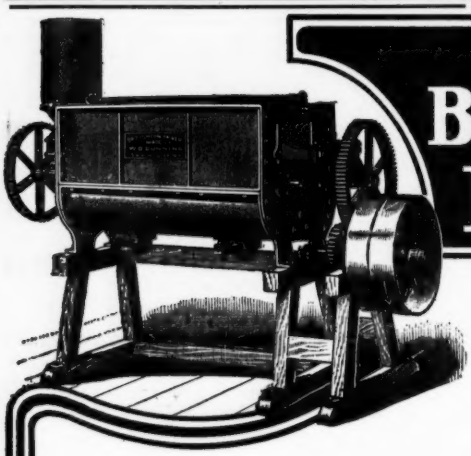

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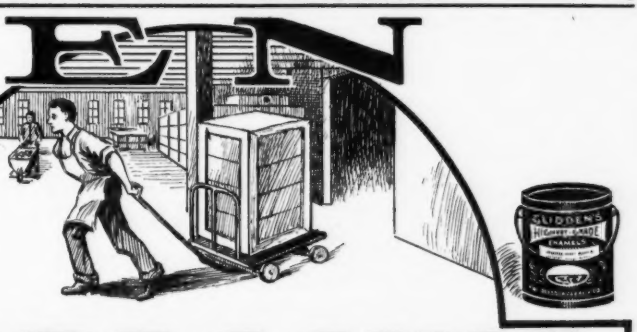

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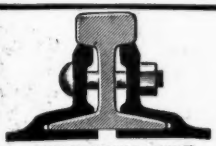

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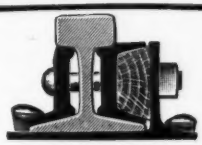

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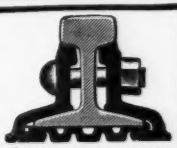

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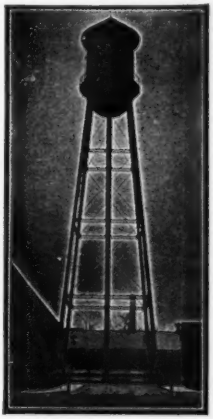

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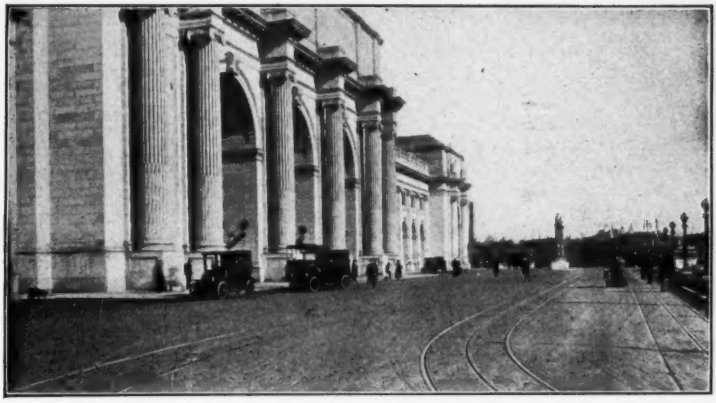

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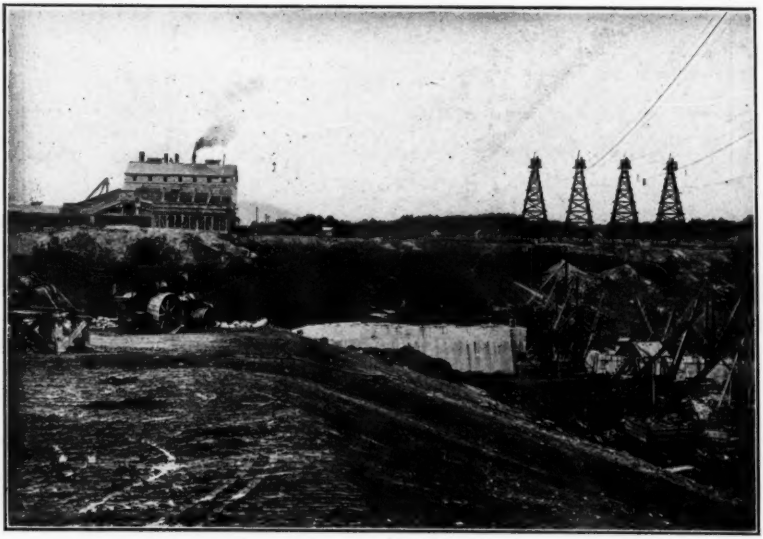

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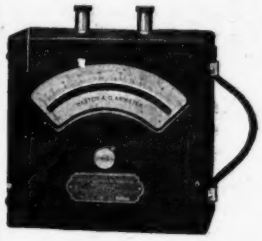

are so far superior to those of any other manufacture that their performance will be a revelation to users of alternating current apparatus.

They are absolutely dead-beat and extremely sensitive. Their indications are practically independent of Frequency and of Wave Form.

They are practically free from Temperature Error.

They require extremely little power for operation.

They are REMARKABLY LOW IN PRICE.

Correspondence concerning these types is solicited by the

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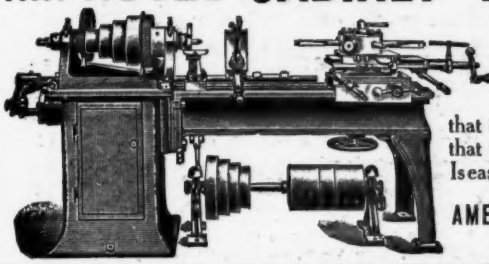
OUR No. 2 IMPROVED CABINET TURRET LATHE



Gives the best possible results in lathe work. Is firm and compact, with no chance for spring or chatter, and so arranged that the centers, "agree," which means that work is bound to be accurate.

Is easily operated. Has many special features.

Write for Catalogue.

AMERICAN TOOL & MACHINE CO.

Founded 1845. Incorporated 1864.

BOSTON, MASS.

MORISON SUSPENSION FURNACES

For Land and Marine Boilers

UNIFORM THICKNESS, EASILY CLEANED.
UNEXCELLED FOR STRENGTH.

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FOX CORRUGATED FURNACES

Sole Manufacturers in the United States.

THE CONTINENTAL IRON WORKS,

West and Calyer Sts., BOROUGH OF BROOKLYN, NEW YORK

Near 10th and 23d St. Ferries

Does the word ADVERTISING confuse you?

WITH your advertising for 1911 in the hands of a concern who have had, say, 20 years' experience, and who represent the advertising interests of some of the largest manufacturers in their respective fields, the word "Advertising" would have no terrors for you.

Such a concern would know *what* to do, *when* to do it and *how* to do it. We are such a concern. Write us.

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The Wm. H. Bristol Electric Pyrometers

Write for new 56 page illustrated catalogue No. 130, giving full information about Indicating and Recording outfits of the Wm. H. Bristol Electric Pyrometers, including partial list of more than seven hundred users.

THE BRISTOL COMPANY,
Waterbury, Conn.

TAPS & DIES

"YOU CAN COUNT ON CARD QUALITY" ‖ **S. W. CARD MFG. COMPANY**
MANSFIELD, MASS., U. S. A.

Jenkins '96 Packing forms a perfect and lasting flange joint

It is made of high-grade rubber composition, soft and flexible enough to readily fill up any roughness or slight unevenness of surfaces.

When steam is turned on it vulcanizes in place without losing any of its strength or toughness, and thus makes a tight and permanent joint. It is light in weight, and consequently low in price.

Give it a trial in one of the severe places. It is guaranteed.

JENKINS BROS., New York, Boston, Philadelphia, Chicago.

GLEASON WORKS
ROCHESTER G E A R S NEW YORK
& GEAR PLANERS

SMALL STEEL CASTINGS, SOFT AND EASILY MACHINED
MALLEABLE IRON CASTINGS,
STANLEY G. FLAGG & CO., PHILADELPHIA, PA.

The Wyman & Gordon Co.
MAKE

DROP FORGINGS
THAT ARE STRONG
FORGED WITHOUT WELDS
WORCESTER MASS. CLEVELAND OHIO.

IMPROVED MACHINERY

NEW METHODS NEW MATERIALS
NEW PROCESSES NEW APPLIANCES

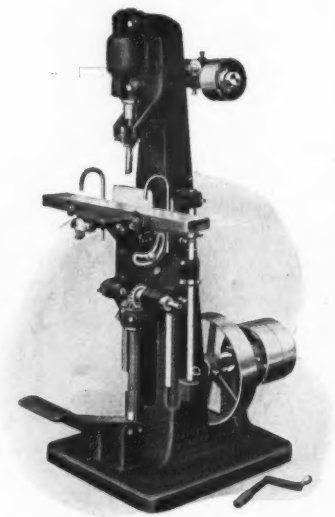
Intelligent Publicity.

—Mr. George H. Jones, Vice-Presient of the Inland Steel Company, Chicago, enjoys the distinction of being the first steel manufacturer to demonstrate, conclusively, the effective value of intelligent publicity in marketing a strictly staple product of iron and steel. Manufacturers of machinery of every kind long ago discovered the invaluable service which the engineering press can render in making known the merits and performances of special and standard types of machinery, but in the iron and steel trade, advertising has always been accounted a useless waste of money. And Mr. Jones is the first man to conclusively demonstrate the contrary.

Sharing in the phenomenal prosperity which preceded the panic of 1907, the Inland Steel Company found it necessary, not only to enlarge and perfect their equipment for handling every stage of their product, from the ore to finished sheet, but also to increase their sheet capacity by full 80 per cent. Just after this new and extensive enlargement of their works had been completed, the heavy slump in the iron and steel trade came on, and they were confronted with what promised to be a prolonged period of dull trade and price-cutting warfare among sheet-steel manufacturers. Having brought their equipment to the highest standard of efficiency, and knowing their product to be the best that could be made, Mr. Jones took the position that Inland sheets would undoubtedly command a full and fair market price—provided their merits were made known in the trade, and their quality absolutely guaranteed. Winning over his associates to this view of the situation, he secured an advertising appropriation large enough to cover full-page spaces in all the leading engineering, construction, and iron and steel journals, and he engaged Mr. R. R. Shuman, formerly of the *Iron Age* staff, to write the story of Inland sheets in a beautiful illustrated pamphlet, 34 pages, of which 10,000 copies were published. Then for a full year past, week after week and month after month—always in full pages and often in double-page advertisements —Mr. Shuman has been telling a pithy, pointed, and thoroughly interesting story of Inland sheets, which it has been a pleasure and an inspiration to read. And what is the result? The Inland Steel works have been running full time at full capacity, in spite of the dull trade of which all other leading manufacturers have been complaining; the largest jobbers in the middle west and south—indeed, from every part of the country—frankly state that they find it necessary to carry Inland sheets in stock, because of the constant and insistent demand for them from customers; and the most significant and gratifying feature of the experiment is the fact that the guarantee of quality, pledged in the published advertisements, has enabled the Inland Company *to maintain its price*, hold its customers, and gain new ones, in spite of continuous price-cutting competition.

Vertical Hollow Chisel Mortiser.

THE accompanying illustration shows a vertical hollow chisel mortiser manufactured by J. A. Fay & Egan Co. This machine will mortise to a depth of 3 inches, or by reversing the stock, it will mortise through 6 inches. It accommodates chisels from ¼ to ¾ inches square. The frame is a single piece casting with good floor support, and is perfectly rigid. The table is 4½ inches wide and 30 inches long and is moved by foot



VERTICAL HOLLOW CHISEL MORTISER.

power a distance of 6 inches. It is provided with clamps to hold the stock, and angles 40 degrees in either direction. It is adjusted up and down by crank and bevel gears, is gibbed to the column of the machine and is provided with stop rod to regulate depth of mortise. The chisel mandrel is made of the best grade of crucible steel and runs in self-oiling bearings lined with genuine babbit.

For further information concerning this new tool, write to the manufacturers for large illustrated circular. Their address is 212-232 West Front street, Cincinnati, Ohio.

"Baird" Reels.

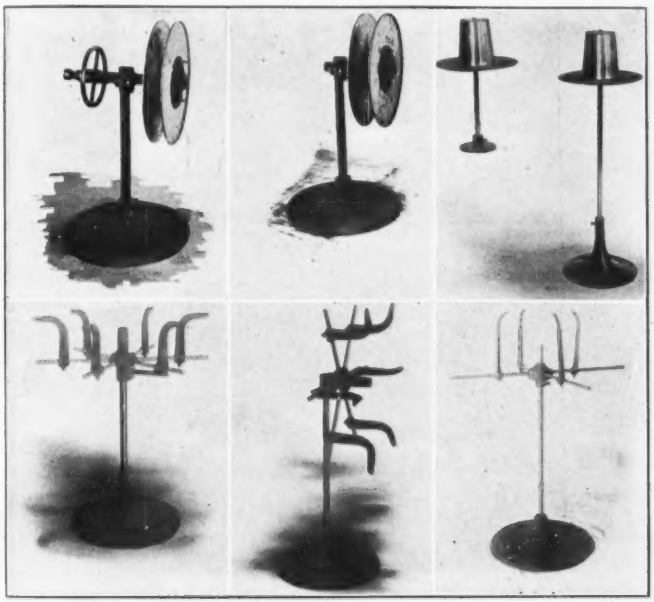
THE illustrations herewith show the wire reels used in standard and automatic wire forming machines, and the sheet metal reels most generally used in presses. These reels are furnished with Baird presses, but in smaller form and attached directly to the press.

Referring to the sheet metal and scrap reels, in the upper row, it will be seen that the pins which receive the coil of metal are adjustable so that coils of varying inside diameter can very easily and quickly be accommodated. The outer flange is also adjustable for width of metal, being held in place by a thumb screw. Furthermore, the reels are interchangeable on the stud or shaft, so that in case metal is required to be run through the press again, the reel from the scrap reel with the metal in it can be put on the scrap reel and the empty reel from the metal reel put on the scrap reel, thus saving considerable time and labor. The flanges are made of varying diameters to suit requirements, and have two radial slots through them to allow of the binding wire being cut from a new coil after the coil is placed on the reel, and also allows the operator to bind a coil of scrap metal before taking it off the reel, thus, in both cases, doing away with the very awkward handling of a loose coil, and also does away with the metal coil opening up about the room. The shaft bracket is also adjustable on the stand, giving variable heights, and the base is heavy, making the reel very rigid, not requiring it to be secured to the floor.

The drum reels here shown are used for the smaller machines and can be

mounted on benches when manufacturing small springs, garment eyes, etc., and the drum reel with floor base is used with the smaller type of standard automatic machine.

The adjustable arm reel shown, besides covering a wide range, is improved by having the ends of the fingers turned inward so as to catch the loose inner coils of wire and force them into place as the coil of wire is dropped on to the reel, thus doing away with the loss of time caused by the use of the old finger reel, which would catch into the loose coils. Another photograph shows the universal arm reel, which also possesses this feature and which can be used in a vertical or horizontal position. These reels are also provided with heavy floor bases so that it is not necessary to fasten them unless desired.



"BAIRD" REELS.

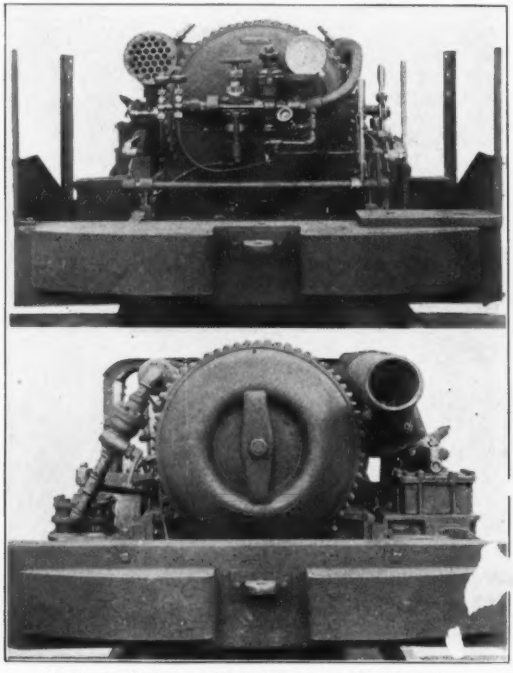
Full information can be obtained from the builder, the Baird Machine Company, Oakville, Conn.

Two-Stage Compressed Air Locomotives.

IN the past thirty years, single-expansion compressed air locomotives have been operated, in gradually increasing numbers, in mines and over industrial railways. The cost of the compressor, pipe lines and charging stations, together with the cost of power to operate the compressor, all of which were usually somewhat in excess of the cost of equivalent items for other forms of locomotives, limited their use to industries and localities where a locomotive that operated without smoke, fire, sparks or wires was of the first importance.

The first two-stage compressed air locomotive was used in a mine of the Susquehanna Coal Company at Nanticoke, Pennsylvania. Before any tests were made the men running it reported that "it was saving lots of air," and later, comparative tests made by hauling the same cars the same distance, over the same piece of track, alternately with the two-stage and then with a single-expansion locomotive of equal capacity, demonstrated that for six separate trips, with variable loads, the average air consumption of the two-stage was 56 per cent. of that of the single-expansion locomotive. The increased efficiency was obtained by expanding the compressed air in two successive cylinders, in connection with atmospheric interheating during the process of expansion.

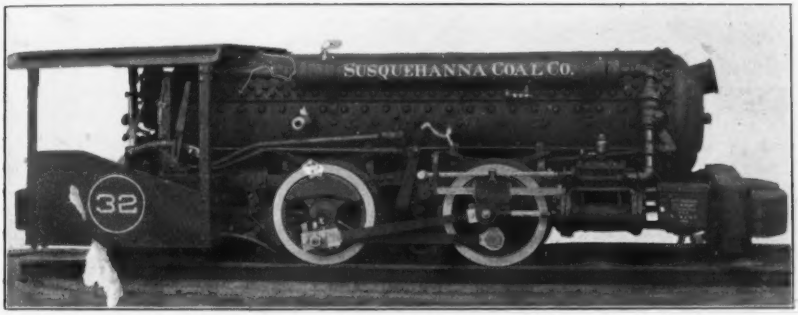
This locomotive is shown in three views. The air is stored, at a pressure of eight or nine hundred pounds, in the large cylindrical reservoir, which may be recharged in two minutes from a stationary storage. The air reaches the high-pressure cylinder through a regulating valve, at 250 pounds pressure and atmospheric temperature. From this cylinder it exhausts through an atmospheric interheater, at a pressure of 50 pounds, to the low-pressure cylinder.



PORTER TWO-STAGE COMPRESSED AIR LOCOMOTIVE.

On account of the work done in the high-pressure cylinder (about 20,000 foot-pounds per pound of air), the temperature of the air leaving the high-

pressure cylinder is about 140 degrees Fahrenheit below that of the atmosphere, rendering the surrounding air an efficient heating medium, which may be readily utilized by means of the interheating cylindrical reservoir filled with small tubes, through which the atmospheric air is rapidly drawn by the ejector action of the exhaust from the low-pressure cylinder. In this apparatus nearly all of the heat lost in the high-pressure cylinder is restored, expanding the air about 36 per cent., and permitting higher initial and lower terminal pressures, with a wider range of expansion—the essential features of economical operation, practically impossible in connection with the single-expansion locomotive, on account of unmanageable refrigeration.



PORTER TWO-STAGE COMPRESSED AIR LOCOMOTIVE.

Since the first locomotive of this type was built, about one hundred more have been put in operation in mines, lumber yards and other industrial establishments. Many of these installations would have been commercially impossible with the single-expansion locomotive, on account of the cost of the compressors, boiler and pipe lines; or because the power to operate the compressor cost too much; or because the locomotive had to be charged too frequently.

The two-stage locomotive has passed through the initial stage of its development, and offers today every desirable attribute of the single-expansion compressed air locomotive, at a considerable reduction in first cost and operating expenses.

The locomotives described above are made by H. K. Porter Company, Pittsburg, Pa., who will send full details on application.

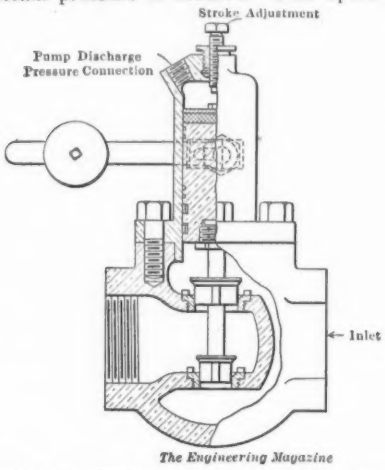
Record Concrete Laying at Gatun Locks.

ALL hourly records for concrete laying were broken on October 6, 1910, by the cableways used in constructing the great locks on the Panama Canal at Gatun. Two million cubic yards of concrete are to be used in building these locks. Lidgerwood cableways are used for placing the concrete. These cableways are aranged in duplex form on four pairs of towers. The pair of cableways which broke the record are known officially as "Strand A" and "Strand B" of Cableway No. 1. Strand A placed forty-nine cubic yards in one hour, and Strand B placed fifty cubic yards during the same hour. This means that the carriage on each Strand made twenty-five trips per hour. The cableways were sold under a guarantee that they would make twenty trips per hour. These cableways are arranged to give higher

carriage speed than was ever attempted before for this class of work. This speed is rendered possible by important improvements made by Mr. Spencer Miller in anticipation of just such needs. With these improvements it is possible to use carriage speeds up to 2,500 feet per minute as against speeds of 800 or 900 feet per minute, which were as great as were before practicable. The cableways each have a span of 800 feet between towers. They are actuated by electricity and the control is as easy and simple and of the same character as the control of an up-to-date electric train. One operator controls the entire operation on each strand.

Gould Differential Governing Valve.

THE Gould differential governing valve admits steam from the closed end of the valve and the steam acts direct on the bottom of piston, the discharge pressure from the pump being connected to top of piston. By weight adjustment, a constant discharge pressure at any desired point in excess over steam pressure is secured. This operation is maintained at all times, regardless of the fluctuation of steam pressure giving constant difference of pressure without variation or adjustment. If the reverse pressure is desired—less discharge pressure than the steam pressure—the weight lever is reversed and adjustment made so that any desired discharge pressure less than the steam pressure is maintained.



GOULD DIFFERENTIAL GOVERNING VALVE.

The governor is constructed in a manner which does not employ the use of valve stem, valve stem stuffing box, springs, diaphragms or leather cups. The valve and valve seats are made of nickel alloy, and are removable. The piston is constructed of nickel alloy, the cylinder of steam bronze. All valve bodies up to and including 2 inch size are of bronze; in larger sizes than 2 inch, iron bodies are furnished. Governors are furnished either straight-way or angle type, screwed ends up to and including 2 inches, flanged on larger sizes.

This governing valve will operate on any steam pressure. The same differential pressure is maintained at all times regardless of fluctuation of steam pressure, and the same governor can be adjusted to operate for any purpose where a steam pump governor is used. The governor is the most sensitive variation of any governor ever constructed.

Fuller information respecting the Gould differential governing valve will be furnished on application to the maker, Safety Equipment Mfg. Co., 181-183 Van Buren street, Chicago, Ill.

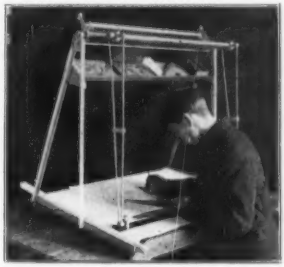
Kelsey Drafting Rig.

THE Kelsey "Economic" drafting rig or lifting swing blade is a practical time saving device that arose from difficulties with long T squares and various forms of parallel blades. Its essential feature is a balanced swing, hung from a rocker, above the draftman's

head, and attached at each end of a vieling blade by jointed connection with a long finger bar, over the latter. In most recent form the swing supports are castings, open at the bottom to permit long tracings to extend beyond the ends of the drawing board, and rapidly sloping away to the rear and top. The swing arms are also curved backward for greater freedom of space.

A skeleton frame at the bottom, with clamps, receives drawing boards without fittings on the latter, and the whole is intended to fasten on any substantial table; or, the swing may be hung from below in a table of special design. Connections with the finger bar permit the blade to accommodate considerable unevenness of the board without disturbing the parallelism. Advantages of the device are its ease of operation and reliability.

Its substantial connections, practically unaffected by wear, the convenient position of the finger bar and the free lift of the blade over obstructions, or its stable position a few inches above as well as on the drawing, make it an economic device in the use of time and mental tension in the operation of blades of 42 inches length or over.



"ECONOMIC" DRAFTING RIG.

Vertical and angular lining, limited as much of it is to short lengths, is most rapidly accomplished with light squares against a fixed horizontal blade. Various forms of these having steel scales with depressed edges and knobs for easy control have been devised in connection with the drafting rig and add much to its efficiency. Descriptive matter will be sent on application to D. J. Kelsey, New Haven, Conn.

Power and Babbitt Metals.

IN figuring on the problems in connection with power transmission no economical plan can very well be carried out unless careful consideration is given to the character and quality of the babbitt metal used in the bearings as a means of minimizing the loss of power due to frictional resistance. The first and most vital matter to decide is whether or not it is wise to use a cheap or ordinary grade of babbitt metal because of the initial saving in cost, or whether it is preferable to apply a high-grade anti-friction metal to all of the bearings in a plant. It is true that some bearings are less trying on a metal than other bearings, and for that reason it is often thought that any cheap grade of metal is good enough for such bearings; but is it true economy to do this? The cost of the babbitt metal itself used in an ordinary size bearing is usually infinitesimal as compared with the cost of labor in applying it. The frictional resistance from the use of a low or ordinary grade metal is waste of power that is reflected back to the boiler in causing a greater consumption of fuel. Such bearings are also liable to run hot and have to be kept flooded with oil, and the wear on the shaft and the bearing is much more rapid. It is very doubtful if these low grade metals have any economic value to the consumer of babbitt. This matter has been threshed out time and again by large manufacturing plants who have found great economy in the use of high-grade metals, effecting in some instances a saving of

33⅓ per cent in fuel, 75 per cent in the consumption of metal and 60 per cent in oil. Of course, such high percentages could not be expected in every case, but are symptomatic, as showing the possible savings to be effected by the use of a high-grade anti-friction metal. Experience has shown that these same bearings, lined with high-grade metals, will usually run from ten to twenty times as long as the ordinary grades and thereby reduce the cost for labor in rebabbitting to an extent that amounts to a considerable item in some plants. There is also to be considered a reduction in the liability of "shut downs."

Of course, the manner in which a babbitt metal is applied is an essential factor in the results to be obtained. This, however, involves no difficulties whatever, as the directions for using babbitt metals are exceedingly simple and are based upon common-sense reasons. There are really only two important rules to observe in pouring a babbitt metal: First, to have all the preparations ready and pour metal as soon as it is hot enough to char a white pine stick. Originally, when this rule was made it was thought that the metal was injured by overheating, and it is true that superheating any metal does impair its vitality, but, as a matter of fact, it was only within recent years that it was discovered that if a white metal alloy was left in a highly fluid state for too long a time the various ingredients of which it was composed would separate; the lead being the heaviest would gradually settle on the bottom and the tin and antimony would work to the top, and a bearing poured in that condition would have soft spots (lead) and hard spots (antimony). As a babbitt metal is a mechanical mixture, it is very important that it should be poured in a homogenous condition.

The next rule is to heat the box and mandrel. If a metal is poured into a cold box and around a cold mandrel it will check its free flow and produce a poor casting. A cold mandrel produces a thin chill on the face of a bearing, and as this chill does not adhere very tenaciously to its comparatively soft backing it will be torn loose by the grinding force of shaft and slough out of the box. Heating the mandrel also burns off any grease or moisture that may be deposited upon the mandrel by finger prints or from other sources, and if allowed to remain upon the mandrel they will expand into gas when covered by the hot metal, and this gas will hold back the metal and cause a blowhole in face of bearing. However, the cheaper or ordinary grades of metals are liable to contain ingredients that produce blowholes no matter what precautions are taken to prevent.

These two simple rules cover practically all the law and gospel of babbitt pouring. There are several other points of minor importance to be observed. If possible, a metal should be peened before it cools off, as a hot metal yields more readily to the blows of a hammer and there is no danger of ever cracking it. Any oxide or scum should be held back and not allowed to enter the box. When a metal begins to change from a silvery to a yellowish tinge indicates the best time to check the heat.

The lack of a proper knowledge of these simple rules has frequently resulted in a good metal being condemned, or failure to secure maximum results. The importance of reducing frictional resistance as a means of gaining an increase of power is obvious. It will often save the necessity of overloading the boiler, besides the other advantages and economies pointed out. This subject is well worth the careful consideration of every user of babbitt metal.

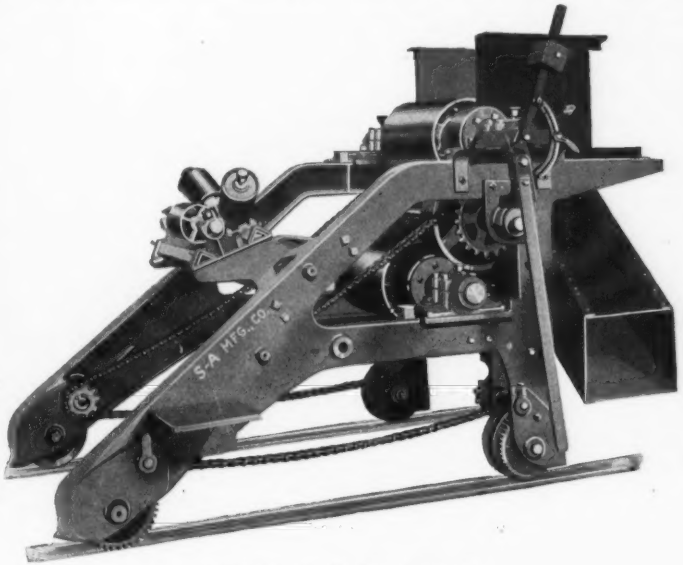
Automatic Reversing Tripper.

THE accompanying illustration shows a new automatic reversing tripper recently put on the market by the Stephens-Adamson Mfg. Co. of Aurora, Ill. There has been a great need in certain classes of work for a tripper of this sort, and it is already in use by a number of the larger mining companies.

The object of a tripper, as is generally understood, is to enable a belt conveyor to discharge its load at any point along the conveyor line. This is necessary when it is desired to discharge from one conveyor into any one of several bins or to distribute the material along one large pile under the conveyor.

Their older self-moving tripper is operated by means of an iron friction wheel working on a shaft between the two tripper pulleys. This friction may engage a paper friction on either pulley shaft, depending upon the desired direction of travel. The shaft is mounted in an eccentric bushing which is operated by a hand lever to make the friction engage its mate on the desired pulley shaft. From this shaft, motion is transmitted to the tripper through all four wheels by means of gears and sprockets.

In the new tripper, the hand lever is replaced by a longer lever, hung vertically from the friction shaft in order to engage with the floor trips. In running against either trip, the lever operates the friction shaft through the eccentric bushing and reverses the tripper's direction of travel. The lever motion is assisted by, and the frictions are held in contact, by means of the adjustable weight shown in the upper part of the picture. This weight may be locked in neutral position whenever it is desired to hold the tripper at one point.



AUTOMATIC REVERSING TRIPPER.

The advantages of an automatic reverse on a tripper are that the tripper may be left unattended to work back and forth between the trips wherever located. In this way the material is piled evenly with no chance of becoming clogged until the whole pile is on the level of the conveyor structure.

The special feature of this tripper is its simplicity of design and its consequent reliability of operation. It is a decided improvement over the old methods requiring cable pulls or complicated and expensive systems of gears. Furthermore, the drive, being through friction gears, is not positive, but will allow for obstructions on the track or accidents in which a positive drive would be a disadvantage.

Industrial Notes.

—Large contracts for Detroit "Fenestra" solid steel windows have recently been made for the new buildings of the Solvay Process Company of Detroit, the Michigan Alkali Company of Wyandotte, and also to fill the openings in additional buildings of the Steel Corporation at Gary, Ind. Recent developments in modern industrial construction are particularly apparent in some of the newer railroad shops finished and in process throughout the country. The new shops of the New York Central at West Albany, and the large new shops of the Chicago & Northwestern at Chicago, show an immense expanse of windows of the "Fenestra" type, made in solid metal bars of rolled steel. In practice this more substantial filling of window openings is shown to be successful and economical.

—The R. D. Nuttall Company has introduced an innovation into railway equipment parts by bringing out case hardened gears and pinions. The Nuttall Company has had a good many of these in service for some time, but deferred announcing the new line until experience had shown that the case hardened gears would perform well under severe conditions. The operation of the gears experimented with has been so satisfactory that the Nuttall Company has decided to make case hardened gears and pinions a part of its regular lines.

—The second annual convention of the managers and department heads of H. M. Byllesby & Co. and affiliated companies will be held at the Congress Hotel, Chicago, January 17 to 20 inclusive. Byllesby & Co., which has headquarters at Chicago, operates and manages a considerable number of electric, gas and street railway properties in the West and South. Since the first convention held last year, several properties have been added to the list and the former attendance of 200 will be largely increased. At a recent meeting of a committee of managers preliminary arrangements were made for a four days' program to be devoted to technical and professional subjects. It is the belief of President Byllesby that the annual meeting and interchange of ideas among managers and department heads accomplishes much towards improving the service offered the public in the various cities where utilities are operated by this organization.

—The Lathbury-D'Olier Company, Engineers, Morris Building, Philadelphia, Pa., announce a merger of the interests of B. B. Lathbury, consulting engineer, (formerly president of Lathbury & Spackman, Inc.,) and of the D'Olier Engineering Company. The company will continue the general and special engineering, manufacturing and contracting business heretofore carried on by the respective interests. B. B. Lathbury, M. Am. Soc. C. E., formerly located in the Land Title Building, Philadelphia, has specialized in the design

and construction of Portland cement plants which included well known plants throughout the United States and foreign countries. The D'Olier Engineering Company, formerly 119-21 South Eleventh street, Philadelphia, mechanical and electrical engineers and manufacturers, have done extensive work in steam, electrical and hydraulic plants, and industrial equipments in this country and abroad. The new company has established executive offices in Philadelphia and an office in New York, and with enlarged shop facilities in Philadelphia are prepared to carry on more extensive work than formerly.

—Recently a contract was let by the Chicago and Rock Island Railroad for a new freight station in Kansas City to take care of the ever-increasing freight traffic, which had to be handled. H. T. Hawk, architect for the Rock Island lines, drafted the plans for the new station. Following other experiences in reinforced concrete building construction, he specified Ferro-Lithic plates, manufactured by the Berger Manufacturing Company, of Canton, Ohio. This Ferro-Lithic plate consists of dove-tailed cross-ribbed steel sheets which act both as form and reinforcement. The concrete is applied on the upper side, while a good plastering surface remains on the lower side. A great saving in time is secured by this construction, since no wooden forms are needed. It also saves the waste lumber inseparable from wooden forms. This construction is to be used for the ceiling of the second floor of the new station, which will be used by the office force. The building is now under course of construction, the contractors being George B. Swift & Co. of Chicago. As the result of this step in concrete construction it is expected that hereafter all similar buildings erected by the railroad along its route will include specifications for Ferro-Lithic. The Kansas City freight station is planned as a model in up-to-date railroad building construction.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

PLATT IRON WORKS CO., Dayton, Ohio.—Bulletin No. 549, showing the Smith-Vaile air compressors, both steam and power actuated.

Buckets.

HAYWARD CO., 50 Church Street, New York City.—An elaborate portfolio showing dozens of illustrations of Hayward buckets and digging machinery in actual work. The devices shown include orange-peel buckets, clam-shell buckets, excavators, dredges, coal-handling machinery, traveling derricks, derrick fixtures, etc.

Centrifugal Pumps.

AMERICAN WELL WORKS, Aurora, Ill.—This is an elaborate catalogue in colors illustrating a very full line of centrifugal pumps, both volute and turbine. This catalogue contains a vast amount of information and data of positive use to any one concerned in the moving of water.

Die Castings.

H. H. FRANKLIN MFG. CO., Syracuse, N. Y.—Descriptive pamphlet illustrating Franklin die castings. In this process molten metal is forced into steel molds under high pressure. The metal is then quickly cooled and the finished casting removed. The result is a casting the counterpart of machine-finished work.

Feed-Water Heater.

NATIONAL PIPE BENDING CO., New Haven, Conn.—A small catalogue illustrating the National feed-water heater, of which more than 3,000,000 H. P. are in daily use. The special features of the heater are that there are no inside joints

to leak; no straight tubes to leak; no back pressure is possible, and there is no contact of water with the shell or iron.

Graphite Products.

JOSEPH DIXON CRUCIBLE Co., Jersey City, N. J.—A pamphlet entitled "Graphite Products for the Railroad," the object being to bring before the mechanical departments of railroads the advantages of graphite products in the proper maintenance of railway equipment.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa.—Record No. 67, being a pamphlet illustrating locomotives recently built for passenger service.

Motors.

TRIUMPH ELECTRIC Co., Cincinnati, Ohio.—Bulletin No. 391, showing Type F direct current steel frame motors designed to supply the demand for a strong, lightweight machine of high efficiency and good-wearing quality.

Pipe Covering.

A. WYCKOFF & SON Co., Elmira, N. Y.—Illustrating Wyckoff's steam pipe covering for underground and exposed steam pipes and hot-water pipes. The Wyckoff covering is constructed of eight seasoned white-pine staves, selected, free of all sap, to insure greater durability. The staves are closely jointed, wound with heavy galvanized steel wire, and then wrapped with two layers of heavy corrugated paper.

Pumps.

BUFFALO STEAM PUMP Co., Buffalo, N. Y.—Catalogue No. 209, showing single, duplex, and triplex power pumps, centrifugal pumping machinery, vacuum pumps and condensers of every description for all requirements.

Recording Gauges.

BRISTOL Co., Waterbury, Conn.—Bulletin No. 140, illustrating in detail Bristol's recording gauges for all ranges of pressure and vacuum.

Separators.

AUSTIN SEPARATOR Co., Detroit, Mich.—Catalogue No. 16, for the year 1911, illustrating the Austin steam and oil separators of standard, receiver, and accumulator types for the elimination of water from live steam, extracting oil and impurities from exhaust steam, and the separation of oil, grit and moisture from compressed air, gas, etc.

DIRECT SEPARATOR Co., Syracuse, N. Y.—An illustrated pamphlet describing Sweet's combination oil and water separators for low-pressure turbines, a field which has called for a combination separator suitable for removing both the oil and the water from the exhaust steam after it leaves the reciprocating engine and before it enters the turbine.

Steam-Power Stations.

STONE & WEBSTER ENGINEERING CORPORATION, Boston, Mass.—A handsome booklet containing photographs of a number of steam-power stations, designed and built by this engineering corporation. The arrangement is particularly attractive.

Steam Trap.

Leaflet illustrating and describing the Kitts T. C. steam trap. Kitts Mfg. Co., Oswego, N. Y.

Switchboard Panels.

GENERAL ELECTRIC Co., Schenectady, N. Y.—Bulletin No. 4749, illustrating alternating-current switchboard panels of the sectionalized type. Each section has a separate catalogue number. The panels are in three sections, and the pages of the bulletin itself are so sectionalized that the user may have before him a picture of the complete panel desired, together with a full description of the equipment.

Turbines.

In addition to building Rateau-Smoot turbines of the high and low pressure types, the Ball & Wood Co., Elizabethport, N. J., announces by means of a new catalogue just issued that it is also building these turbines, which are of the impulse type, for mixed flow pressure. The new type consists of a straight low pressure turbine with supplementary wheels to economically use high pressure steam by means of an automatically controlled governor.

Woodworking Machinery.

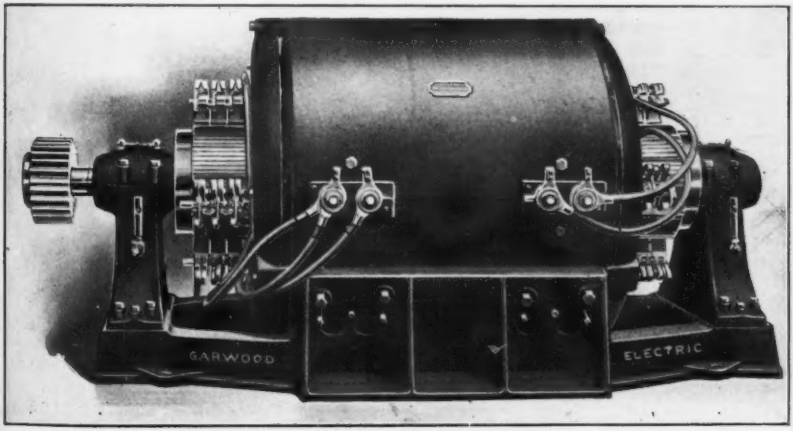
J. A. FAY & EGAN Co., 212-232 W. Front Street, Cincinnati, Ohio.—Catalogue No. 84, of 384 pages, in two colors, profusely illustrated with half-tone plates and bound in a five-color cover. This catalogue is a reduced reproduction of the company's large general catalogue.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Newspaper Press Drive.

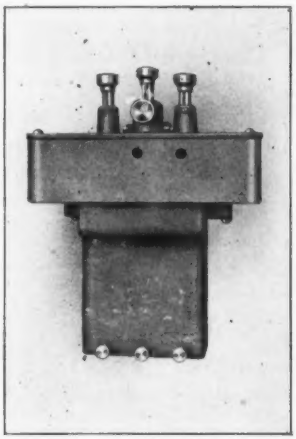
THE accompanying illustrations show the motor and control station as used in the Garwood Electric Company's "station control system" for driving printing presses, which has solved the newspaper press drive. The motor is of the protected type, and is extremely rugged; but a single set of spur gears is used, eliminating all trouble with clutches, worm wheels, or intermediate gears. No change of gears is necessary in color work, as is the case with other systems. The shaft is of liberal diameter; the magnetic frame is split horizontally, permitting easy removal of the top of it, while the removable bearings are of the pedestal type with separate caps and split bushings. Because of its design, no outboard bearing is necessary, although it will be furnished if desired. All parts are readily accessible in the limited space in the motor pit, which with this system is materially smaller than in the two-motor drive.

The brush rigging and brush holders are rigidly designed to prevent vibration being transmitted to these parts by the gears. Owing to the exacting requirements of newspaper press drive, standard commercial motors are not adapted to this service, and will not stand up well under the work. This motor is of the commutated pole type, designed especially



GARWOOD MOTOR FOR NEWSPAPER PRESS DRIVE.

for this particular service, developing the heavy torque required for starting. All speed changes are obtained by field control, and not by the wasteful method of armature resistance, and all danger from sparking and cutting of the commutator is entirely eliminated.



GARWOOD CONTROL STATION.

The control stations include three buttons: (a) starting, accelerating, and safety button for starting and increasing the speed of the press, including inching and "threading in," it being equipped with safety device for locking the press against any further increase in speed until released at the station at which it was applied, but allowing it to be slowed down to ten revolutions, or to be stopped from any station while the press is at "safety"; (b) a slow-down button for decreasing the speed of the press from maximum to ten revolutions of the cylinder; (c) stop and lock button for stopping and locking the press simultaneously and holding it locked until the locking device has been released at the station at which is was applied.

Pressing the stop button not only stops the press, but locks it at every station until the automatic check on the stop button is released at the station where it was applied, thus making it absolutely safe for any pressman, by merely stopping the press, to go under it without danger.

The Garwood Electric Company, Garwood, N. J., have published Bulletin No. 505-G, illustrating and describing in detail their form of newspaper press drive, and they will furnish same free of charge to all inquirers.

Foos Gas Engine Installation.

THE complete success of the two installations of large Foos vertical gas engines by the U. S. Government on the Ohio River improvement work has led to the placing of another order with the Foos Gas Engine Company for six engines, four of which are 100 horse power each, of the three-cylinder vertical type, which will embody the new features of the Foos design. This order will be divided and shipped to two different points, where the engine will be used in the operation of locks which the Government is building in the Upper Ohio Valley to provide sufficient water to obtain continuous freight navigation during the dry season.

The Foos engines were originally installed largely as an experimental measure, but such satisfactory results were obtained that the Government placed the subsequent orders with the same company for the engines in connection with this work, which involves an expenditure of millions of dollars.

The locks at each dam are operated by compressed air furnished by compressors belted direct to each of the 100 horse power Foos units. Each engine will be capable of developing 100 horse power continuously and under rigid specifications regarding speed regulation, fuel economy, reliability, ease of handling, and quickness of starting.

The other engines will be used for auxiliary purposes. The order calls for

Foos engines operating on natural gas, but each unit will be so arranged as to be quickly adapted for the use of gasoline or kerosene, in order to prevent any interruption of the service in case of a shortage or temporary failure of the gas supply.

Turbo-Undergrate Blower.

THE B. F. Sturtevant Co., Hyde Park, Mass., have recently placed a turbo undergrate blower upon the market that deserves careful consideration by all engineers who have supervision of steam generating plants. The construction of these blower sets is simple, durable and strong, and consists of a single stage impulse steam turbine direct connected to a propeller type fan. The bucket wheel of the turbine is a solid steel forging carefully machined, the steam buckets being milled on the periphery of the bucket wheel. The steam nozzles are made of Tobin bronze and are held in place by composition draw-up nuts. The construction of the steam case gives great accessibility for inserting, removing or cleaning the steam nozzles. Ample dust-proof phosphor-bronze bearing and thrust washers are provided, with oil cup lubrication. The construction of the bearing makes it possible to renew the bearing at a small cost.

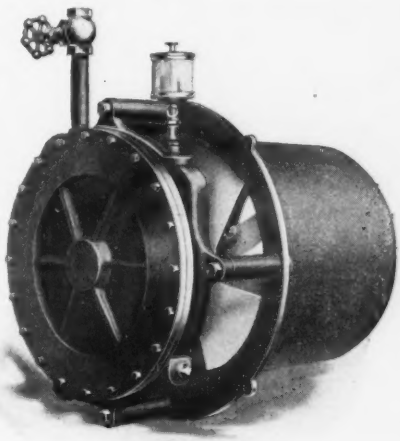
The built-up fan is of the propeller type and consists of six polished sheet aluminum blades rigidly fastened with hard drawn copper rivets into a bronze hub, which is finished all over to secure the proper balance necessary for the high rotative speed of these sets. The materials used in the construction of the fan insure great mechanical strength and also great corrosive resisting power.

The stationary members of the blower set are constructed of cast iron parts of ample strength and rigidity.

The Sturtevant turbo undergrate blower is practically silent in operation and requires a minimum amount of care and attention, as it can be controlled by a hand damper regulation or by regulating valves operated by the boiler steam pressure.

As the exhaust steam from the turbine contains no oil it may be used to best advantage for any work for which exhaust steam may be put, such as feed water heaters, heating, etc.

When discharging into the ash pit it produces excellent results with coals that



STURTEVANT TURBO-UNDERGRATE BLOWER.

would ordinarily cause serious trouble by clinkering.

The cost of installation is exceedingly small. The wall thimble which forms the anchorage for the set can be placed with equal ease in the front, side or back wall of the brickwork of the boiler setting. The ease of installation combined with the small cost of these turbo undergrate blowers should make them of special interest to all plants that desire to increase their boiler capacity, or in cases where the maximum efficiency is not being secured by the fuel.

These blower sets can be applied with excellent results to power plants that fall under the following classifications: (1) electric light and railroad plants that need increased draft during the peak of the load; (2) power plants that

have outgrown their stack capacity and need 25% to 50% increase in B. H. P.; (3) in heating systems for hotels, department stores, flats, schoolhouses, etc.; and (4) in small plants that need an increase in boiler horse power.

Quincy Market Refrigerating Plant.

THE distribution of light, heat and power from central stations or power plants has for years been well established, but the supplying of mechanical refrigeration to the market district of a large city is a comparative innovation and presents many novel features that are exceedingly interesting.

An example of such an installation is that of the Quincy Market Cold Storage and Warehouse Company, of Boston, Mass. This company owns twelve warehouses in the market district of the city, which are rented to wholesale dealers and for which refrigeration is supplied. Beside the warehouses, refrigeration is furnished to the Clinton Market, which is the headquarters of the Chicago packing houses in Boston, and to about seven hundred refrigerators in individual stores.

The power house is at Sargent's wharf, which is embraced by the market district and is admirably situated for economical distribution. The compressors for the refrigeration plant are steam-driven, but the auxiliary apparatus used in connection with the system, as well as elevators, hoists, etc., are operated by electric motors, all of which are furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

For cooling the warehouses, the brine is pumped to coils of pipes in various parts of the buildings and the cooled air circulated to different departments by means of fans. The brine is circulated by a two-stage brine pump driven by a 75 horse power type "CCL" motor, and two single-stage brine pumps, each driven by a 40 horse power type "CCL" motor. The fans are driven by five 10 horse power, four 7½ horse power, two 15 horse power, and one 50 horse power induction motors. For the street system which supplies individual consumers, there is a two-stage brine pump driven by a 150 horse power induction motor, and a rotary brine pump driven by a 100 horse power induction motor.

The motor equipment for operating warehouse elevators consists of five 30 horse power, four 15 horse power and two 7½ horse power induction motors belted to the operating mechanism, and four type F adjustable speed motors of 20 horse power capacity, direct connected to operating mechanism. There are a large number of miscellaneous motor applications, including a 3 horse power type "CCL" motor driving fuel economizer scrapers, a 5 horse power induction motor driving a small machine shop, a 10 horse power induction motor driving the carpenter shop, a 10 horse power "CCL" motor operating hoisting whips, a 7½ horse power induction motor driving pipe shop, four 5 horse power induction motors driving meat grinders, a 15 horse power "CCL" motor driving drum hoist, a 3 horse power type "CCL" motor driving centrifugal circulating pump for office hot water heating system, a one horse power type "CCL" driving pressure oil system for oiling engines, and a 10 horse power induction motor driving a triplex pump.

Power is furnished by a Westinghouse 300 kilowatt, two-phase, 60 cycle, 450 volt, turbo generator excited by a 10 kilowatt, 125 volt, direct current generator.

Hayward Skid Excavator.

THE accompanying illustration shows the Hayward skid excavator with the steel "A" frame and boom mounted on a wooden frame. This type of machine may be used in three ways. The first, as shown here, as a machine with a bull wheel, stationary topping-lift and

automatic bucket. The second type is made by adding a sheave and substituting sheave block at the apex of the "A" frame. With this change a variable topping-lift may be used. The third style is when the bull wheel is entirely eliminated, two swivel blocks are placed on the "A" frame sill and two more on the "A" frame, and the lines led to the engine drum, making what is called an automatic swing. This can all be done with the same machine.

It can be knocked down and set up more quickly than a machine built entirely of wood. All its material is lighter and cast in smaller pieces so that it is far easier to handle and transport from one place to another, thus saving time, money, and labor.

The "A" frame and engine can be removed from the platform and placed on a scow, thus making a standard type of dredge. By adding a few bracing rods and extra timbers the machine can be mounted on wheels, making a machine of wide gauge. The "A" frame and sill may be mounted on an ordinary flat car and used as a traveling machine on a standard guage road. When so arranged, however, it can only be used on sidings as the "A" frame would project too far to use on main railroad lines. If the machine is rigged to use a variable topping-life the bucket may be eliminated, and the

HAYWARD SKID EXCAVATOR.

machine then used as a regular derrick or as a contractor's derrick.

Pamphlet No. 565 describing this excavator in detail will be sent free on request by the Hayward Company, 50 Church street, New York.

Friction Losses.

SCIENTIFIC tests by prominent authorities have proven conclusively that friction losses are much reduced and the carrying capacity of the bearings greatly increased when the lubricant contains the correct proportions of Dixon's flake lubricating graphite, and these tests are proven by actual experiences.

Sometime ago Prof. W. F. M. Goss, Dean of the College of Engineering, University of Illinois, made some tests with the Dixon flake lubricating graphite on ball bearings. As a result of these tests, Professor Goss says in part that the following conclusions may be drawn:

"A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard oil alone will do and which at the same time will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry.

"An oil as light as kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium heavy pressure.

"Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used.

"The admixture of graphite with either a liquid or viscous lubricant, serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry."

The Joseph Dixon Crucible Company of Jersey City, N. J., have a record of Professor Goss' extensive tests with graphite as a lubricant published in pamphlet form under the title of "A Study in Graphite," which is sent free on request.

Electrolytic Lightning Arresters.

MANY devices have been placed on the market for the protection of electric equipment from abnormal voltage on the line, due to lightning or any other cause, but without question the most effective piece of apparatus ever devised for this purpose is that type of lightning arrester which depends upon the safety-valve action of a film on an aluminum plate. This type is commonly known as the electrolytic arrester and, in practice, consists of nested aluminum trays filled with electrolyte and submerged in oil.

The electrolytic lightning arrester has ideal characteristics, and very closely resembles in action a relief or safety valve, which it truly is for the electric system. The horn gaps which are between the arresters and the line break down on over voltage and if this voltage amounts to over approximately 330 volts per tray, a free passage through the film from tray to tray and thence to the ground is provided. When the voltage drops to normal, which is below the critical voltage of the tray, the apparent resistance of the film reasserts itself and the flow of the current is cut down so that the horn gaps disrupt the arc and all further flow of current ceases.

The nested trays are placed in oil-filled, welded steel tanks, which for 22,000 volts and above are built with cast covers and outdoor terminals, so that the entire arrester can be placed outdoors. The complete arrester consists of four tanks mounted on an insulated platform for ungrounded neutral service, and three tanks grounded for grounded neutral service. For 13,200 volts and under, the

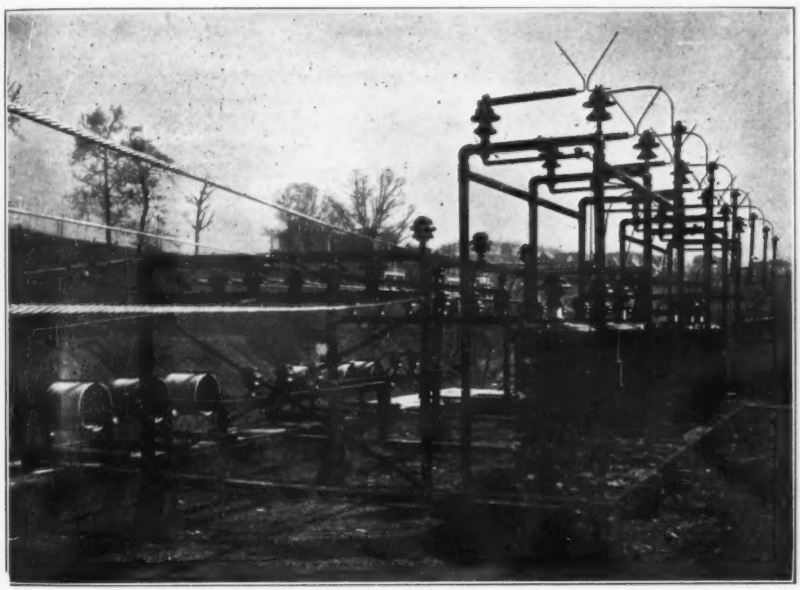
arrester is arranged for indoor service only, as the horn gap setting is so small that much more effective service is obtained when the arrester is housed. For the lower voltages the general arrangement of trays is the same, but a smaller number of tanks is used.

Since the film on the plates dissolves when the electrolytic type of arrester is allowed to stand without current passing through it, it is necessary to pass current through the arrester periodically in order to keep the film in the best condition. This prevents an abnormal rush of current when the arrester discharges after a long period of idleness.

The rate of dissolution of the film depends upon the kind of electrolyte used and the temperature. There are two kinds of electrolyte made by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.; one which requires that the horns be bridged daily to pass current through the arresters, and the other which requires that the horns be bridged only every seventh day. The latter electrolyte has been known to stand without current for very long periods during cold weather, and when the horns were bridged no undue rush of current followed. However, in order to keep the films well built up, it is recommended that current be passed through this electrolyte every seventh day; this offers no inconvenience, as apparatus in general should be inspected at least this often.

When arresters are bridged at normal voltage, a bluish, crackling static arc indicates the normal condition of the arrester. If the arc is reddish and fluffy, and rises high on the horns, it is evident that the bridging of the horns has been deferred too long a time, and it will take a short period before the arc comes down to normal.

The horn gaps and bridging device are mounted on a two-inch pipe frame, to which is also attached the transfer switch



ELECTROLYTIC LIGHTNING ARRESTER.

used for interchanging a ground and phase tank on ungrounded neutral arresters. The bridging device is very simple and can be operated from either end.

As the voltage increases the number of trays in the arrester also increases. Hence, for a higher voltage, if the trays were all built in a continuous structure, it would be very awkward to handle and require considerable overhead room when installed indoors. For this reason, on all arresters above 13,200 volts, the Westinghouse tray structure is built up into sections containing not over 50 trays, which slide into place, one above the other, between guides supported by a base casting fitting closely to the bottom of the tank. Each section when filled with electrolyte can be easily handled without danger of upsetting it. The electrolyte is poured into the trays by means of a measuring cup, which contains the correct amount of liquid for each tray. When a section of trays is filled the electrolyte is plainly visible so that each tray can be checked.

All parts of the supporting frame directly in contact with the trays are made of the best grade of porcelain; hence, any danger due to burning supports, which is likely to be present in case wood is used is entirely eliminated.

If a ground on one phase occurs when the horn gaps are set to get the maximum protection from the arrester, the horn gaps connected to the other phases will discharge until the line is cleared, or is thus subjected to a continuous discharge that may last a long time, the Westinghouse arresters are designed with large tanks holding sufficient oil to absorb the heat of a continuous discharge lasting over a considerable period. The tanks are built large in diameter so that the clearance between the top tray and tank where the maximum voltage exists provides a good insulation factor of safety.

Centrifugal Tar Extracting Apparatus.

PERHAPS the greatest difficulty encountered in the operation of gas engines in connection with soft coal producers is in the proper cleaning of the gas. The raw gas as it comes from the ordinary up-draft soft coal producer is unfit for use, as it contains a very large percentage of vaporized tar, lamp black, ash and sulphur. Of these impurities tar, even in very minute quantities, is most detrimental to the operation and proper regulation of the gas engine. This is owing to the fact that so long as there is any tar vapor present in the gas it will condense on any metallic surface. The condensation is greatest wherever there is a sudden change of direction, or a sudden change in velocity as in passing through the valves of the gas engine. A continued deposit of tar on these parts soon causes the engine to regulate badly and in time prevents governor action altogether, causing breakage of the valve mechanism and other parts of the engine, causing the engine to stop completely owing to insufficient supply of gas for the load, or permitting the engine to run away owing to an excess supply of gas. Thus it may be seen that thorough cleaning of the gas is necessary in producer power plant operation. Indeed it is this feature which has been the great drawback to the general adoption of the gas engine for power production. It is only by use of some thorough and reliable means of cleaning the gas that the producer operated gas engine may be placed in the same class with respect to reliability as the steam engine or steam turbine.

As an example of the efficiency of a modern system of purifying producer gas, the equipment of the Penn-American Plate Glass Company, at Alexandria, Ind., is of special interest. A portion of their power equipment consists of a producer operated gas engine plant comprising three 500 horse power Koerting, and a 300 horse power vertical Westinghouse engine, engines direct connected to generator, making a total of 1,800 horse power, which may at times be subject to 10 per cent. overload. These engines are supplied with gas by four 500 horse power updraft soft coal producers of the usual type. An interesting feature of the installation is that no gas

holder is used or found necessary, and when under full load the engines draw their own gas under a vacuum of ½ inch to 1 inch water gauge. The producers are supplied with forced draft by means of steam jets or inspirators, which provide sufficient pressure to overcome resistance of the fuel bed and to deliver the raw gas into the main under a pressure of from 1½ inches to 2½ inches water gauge, whence it passes through the cooling tower to the tar extractor. This plant has been in operation for a number of years, but has until recently been operated with the greatest of difficulty owing to the impurity of the gas. This was in part due to the fact that the coal used was unusually high in volatile matter, but more particularly to the fact that the two types of scrubbers previously used proved inefficient. Both of these scrubbers comprised a cylindrical stationary shell within which was a rotating cylinder provided with numerous exterior blades or paddles. An ample supply of water was introduced between the rotating and stationary drums. Not only did these scrubbers prove unsatisfactory as to the removal of tar, but they gave a great deal of trouble by getting out of balance, owing to accumulation of tar upon the rotating parts while in operation. They were finally abandoned, and in March last a Buffalo turbine tar extractor, manufactured by the Buffalo Forge Company, of Buffalo, N. Y., was installed, which has been in satisfactory operation ever since. This extractor is of the centrifugal type and comprises an outer cast iron shell, which is divided vertically into two separate stages, each provided with a rotor. The rotors are constructed entirely of monel metal, which is a natural alloy of about 80 per cent. pure nickel and 20 per cent. copper. This is the most nearly acid proof construction metal known, with the exception of lead, and is scarcely affected by the action of the sulphuric acid in the gas. It also has the advantage of possessing the high tensile strength of about 80,000 pounds per square inch.

All interior parts of the scrubber are of cast iron or monel metal. The shell is provided with numerous hand holes for inspection of all parts, and in addition is divided horizontally so that the entire rotor and shaft may be removed without disturbing the bearings or the alignment of the casing. The shaft is mounted upon self-aligning spherical ring oiling bearings which are attached to the shell of the extractor. The extractor is driven at 1,800 revolutions per minute by a direct connected 60 horsepower Terry steam turbine.

The water is thoroughly distributed to all parts of the scrubber by means of cyclone nozzles at a pressure of about 15 pounds. These nozzles, which are also of monel metal, are of the atomizing type and of the simplest construction, operating on the centrifugal principle. This type of nozzle is particularly adapted to this service, since its interior is free from any obstruction which would tend to collect foreign material in the water. As an additional precaution, the water is first passed through two Buffalo pot strainers, which permit easy cleaning while the plant is in operation. The nozzles are supplied with water through cored chambers in the shell, and by a special construction are all made accessible from the outside. About 85 gallons of water per minute is required for operation.

The beneficial effect of the second stage is shown both in the greater economy of water consumption, and the marked increase in efficiency of cleaning. The difference in the color of the water of the two stages is most marked.

It is interesting to note that after a long period of operation not the slightest trace of tar or lamp black was to be found in the gas main leading from the scrubber. The four gas engines are operating continuously 24 hours a day, 6 days a week. Examination at the end of the week has shown that any cleaning of the engine was unnecessary. The absence of tar in the gas permits the governors to regulate perfectly, no trouble

having been found from this source since the installation of the Buffalo apparatus. Breakdowns and failures of the engine, which had previously been so common, are now substantially done away with. Indeed the experience with this plant has shown that the proper cleaning of the gases is the most difficult as well as the most vital feature of the producer installation. Tests upon the cleaned gas showed only a trace of foreign material, the amount being .00031 grains per cubic foot. This seemed in part to be a very little tar and partly a very fine lamp black, this amount, however, being so small that it had no effect whatever on the engine. A particularly pleasing feature of the installation is that the construction of the rotor is such that there is no collection of tar on any part of it to produce an unbalancing and a consequent vibration, which had been found so serious with other types. Examination of the rotor after long periods of operation show it to be as free of accumulation of tar as upon the first day of operation. The balance of the rotor remains so perfect, that it is difficult to tell when the machine is running. The scrubber receives a thorough cleaning with steam once a week, which is all that is found necessary; this requires about one-half hour, and necessitates no manual work whatever.

The Rife Hydraulic Ram.

THE improvement made in the construction of hydraulic rams from the day of their invention by Montgolfier, in 1776, was practically nil until the Rife ram was designed. The Rife machines are now built with automatic, air feeding device preventing water-logging and destruction by concussion, and are now being used for town water works, irrigation and railroad tank supply, as well as for farms, domestic purposes, etc. The following illustration shows a plant installed for the Pennsylvania Railroad Company. The water used to operate the Rife rams is conveyed through a 6 inch pipe line, 1,400 feet to the intermediate reservoir, to which the drive pipes are connected, as shown on the accompanying illustration. Fall used, 12 feet; water used, 120 gallons per minute; pumping head, 39.4 feet; water delivered, 28 gallons per minute; efficiency developed, 70 per cent.

Over thirty of the prominent railroad systems use Rife rams, which effect considerable saving, as they run constantly without attention or expense except for

RIFE HYDRAULIC RAM.

new valves every year or two, thus eliminating the cost of fuel and attendants. A plant recently installed for a town in Kansas delivers 600,000 gallons of water daily, replacing a steam plant that cost $25 a day for operation, the rams costing less than fifty cents per day for maintenance. The Rife Engine Company recently received a single order for one hundred of these machines for a South American Government contract. They claim for their rams: constant operation under two or more feet fall, water elevated 30 feet for each foot of fall used, and efficiencies ranging from 60 per cent. to 90 per cent.

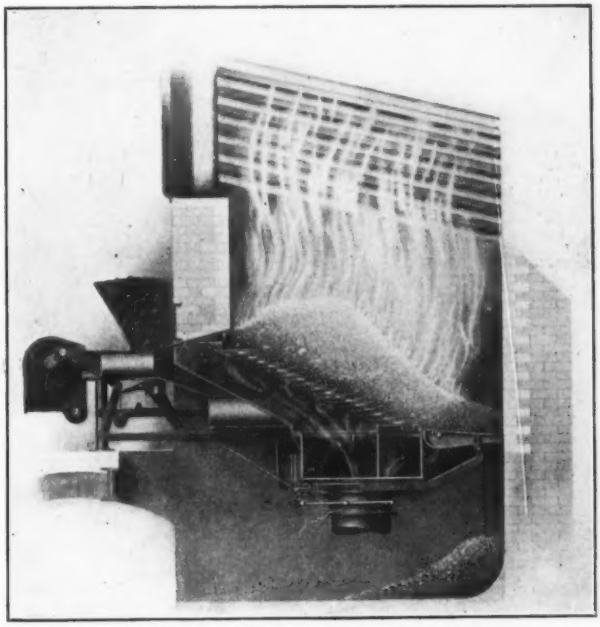
Catalogues, estimates, drawings and blue prints will be sent free upon request.

Improved Stoker For High Rates of Combustion.

THE Taylor stoker has been developed to dispose of the refuse so readily that coal can be burned in the large quantities necessary for operating boilers at double their rated capacities. It makes possible the concentration of load on a few boilers and the minimizing of losses by maintaining intense fires and rapid circulation. It thus meets the conditions of what undoubtedly will be the boiler practice of the future.

The difficulties encountered in the disposal of the large amounts of ash resulting from high rates of combustion have been overcome in the Taylor by feeding the coal beneath the burning fuel, at an angle to the fire surface, so that gravity is utilized in carrying the burned-out coal to the dumping plates at the rear as well as in the distribution of the fuel. No other stoker can burn so much coal, simply because no other can take care of so much refuse.

From the first, the fundamental design of the Taylor has remained unchanged because of early recognition of the importance of ash removal; but improved mechanism has been necessary as larger and larger stokers have been called for. These changes relate principally to the operation of the lower line of plungers, which push the burned-out coal onto the dumping plates.

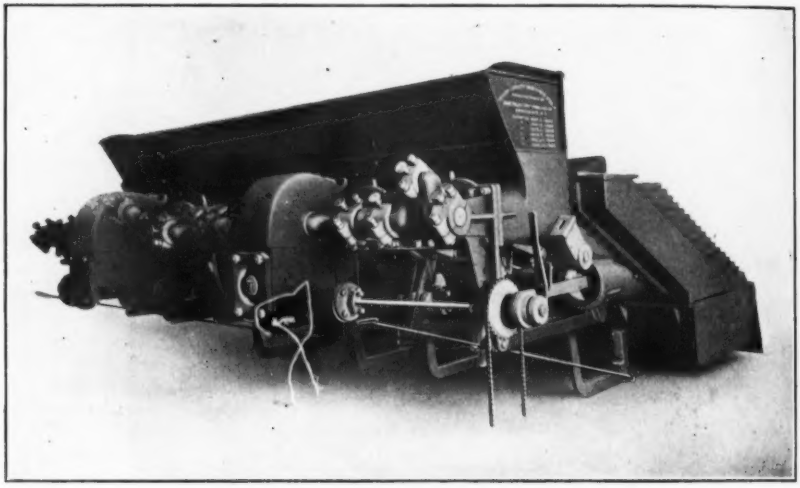


SECTIONAL VIEW OF TAYLOR UNDERFEED STOKER.

The travel, or length of stroke, of the upper row of rams which assist gravity by pushing the coal outward into the fire is constant, but the travel of the lower row can be increased to push the refuse out more rapidly just after the dumping plates have been dropped, or whenever it is desired to more quickly get rid of the refuse which has collected in the lower part of the furnace.

As previously built, each lower ram was connected directly to the bell crank which operated the upper plunger. Adjustment of the stroke of the lower plungers was made for each separate retort. With the improved mechanism, the travel of all the lower rams may be lengthened or shortened simultaneously. This is accomplished by means of sort of pantograph lever connection having a cam and balance weight on the upper member. Pivoted to the plunger connecting rods, these cams are connected by means of chains, lever arms and shaft to the operating handle at the center of the stoker. To alter the travel of the lower rams the adjusting lever is dropped, releasing the cams and permitting them to become horizontal, which action lengthens the stroke of the plunger. In case the vertical connection of the bell crank lever is in such position that the cam cannot drop, it merely remains at rest until the connection moves backward and the counterblance weight falls and carries the cam into position.

Another change which simplifies the operation of the stoker is the relocation of the speed shaft sprocket. It is now placed at the end of the stoker with the clutch and face plates which hold the shearing pin on the outside. This greatly facilitates the replacing of the shearing pins when required and also the throwing of the stoker on or off the line. It also improves the connection to the fan shaft.



PERSPECTIVE VIEW OF TAYLOR UNDERFEED STOKER.

A third improvement is the alteration of the dumping plates. In early forms, the dumping plate was cast in one piece, but the present design calls for a dumping plate in sections which are independently renewable, facilitating and lessening the cost of repairs. Improvements of minor importance, but which nevertheless make for simplicity, more certain operation, and reduction of repair charges, are the use of lock nuts in all places where possible jar would tend to loosen ordinary nuts, the fitting of the crank shaft brackets to the ram boxes with body bound bolts, and an increase in the size of the gears in the gear boxes and the shaft and bearings. To insure

more certain connection between the cast-iron ram boxes and the tuyere boxes they are now carefully doweled together.

Air Compressor Lubricator.

THE Detroit Lubricator Company, Detroit, Mich., has recently put out an air compressor lubricator which marks an improvement over previous devices for lubricating the air cylinder of air compressors. The Detroit air compressor

AIR COMPRESSOR LUBRICATOR.

lubricator can be started and stopped without changing the feed and pressure adjustments. It is not even necessary to touch them. The Detroit "500," as it is called, has three valves. An oil valve controls the admission of oil to the valve, which in turn regulates the rate of feed. A valve in the support arm prevents excessive back pressure which would cause the oil to spatter the sight feed glass. The oil supply valve allows a permanent adjustment of the feed and pressure valves, because it alone controls the admission of the oil to the feed and the other valves do not have to be turned off to stop the feed and turned on to start it. After the adjustment is once made it stays right, because it never has to be changed.

There is no waste of time, effort and oil every time the machine is started. All the operator has to do is give the oil valve three or four turns and the oil runs through the other valves just as it did the day before, and the day before that, because the adjustment is exactly the same and was not changed. The economy in oil is considerable. It has none of the disadvantages of the leaky snap stem type.

The Detroit "500" is strong and substantial throughout, designed for rigorous service and carefully made. The gauge glass in the body is of the bull's-eye type and capable of withstanding any pressure to which it may be subjected. This lubricator is furnished in two types, the "500" regular with heavy tubular glass for pressures not exceeding 300 pounds, and the "500" extra heavy with bull's-eye glass for pressures of 300 pounds or more.

Pluvinox Reinforced Railroad Roofings.

"PLUVINOX" is a ready roofing, especially designed in its ingredients and construction to withstand the smoke, cinders, fumes, sparks, vibration, wear and tear, and other severe conditions of railroad work. Such a use and test commend the roofing for any class of buildings, particularly foundries, gas plants, acid works, factories, and structures near the sea.

Salt air destroys tin and iron, but does not injure "Pluvinox" roofings. They are also alkali and acid fume proof.

"Pluvinox" roofings are (except the one-ply) built up in layers; that is, they contain from two to three sheets of fabric, with layers of waterproofing compound between the sheets, all thoroughly bonded together. The completed material is, in addition, coated top and bottom.

This roofing costs less than tin or shingles; does not rust like metal; is a

non-conductor of heat and cold, and, therefore, insulates the roof. It is also odorless and does not taint rain water.

It is adapted to all climates, to flat or steep roofs, to any class of building, and can be easily applied. It is made in four weights, two reinforced, and two unreinforced. The two reinforced grades are unexcelled for their great strength. It is practically impossible to tear them with the hands.

"Pluvinox" is made by the Hydrex Felt and Engineering Company, 120 Liberty street, New York.

The Oneida Steel Pulley.

IT is only in comparatively late years that the idea of a pulley made entirely of steel has presented itself. The economy of such a pulley is very evident,—it is light, strong, serviceable and looks well on the shaft. Later on it was found that steel has certain properties which afford the best belt adhesion known.

Various companies began the manufacture of all-steel pulleys. Some failed in their purpose; others brought the steel pulley to a point where it is most economical.

ONEIDA STEEL PULLEY.

Notable among these is the Oneida Steel Pulley Company, Oneida, N. Y.

Their system of construction allows the greatest range of sizes and styles of any steel pulley made. They make pulleys from 6 inches to 126 inches in diameter with a 2 inch to 40 inch face to fit any standard size shaft from 1 inch to 8 inches in diameter. Besides the regular belt pulleys they make such specialties as conveyor drums, elevator, head, tail, and tripper pulleys, flanged pulleys, cork insert pulleys, and flanged pulleys for axle dynamos, used in car lighting service.

ONEIDA PULLEY WITH FISHPLATE REINFORCEMENT OF RIM.

The system of construction used by the Oneida Steel Pulley Company is unique,—one of the most prominent features being the fishplate system of fastening arm to rim, on pulleys above 20 inches in diameter. This fishplate makes a broad bearing for the arm, in fact it may be said that it answers the purpose of a double thick rim with no superfluous weight.

They also insert extra sets of arms or spiders in wide faced pulleys to afford support across every 8 inches of the entire width of the pulley; for instance, a pulley with a 24-inch face has three spiders, while a 40-inch face pulley has five spiders.

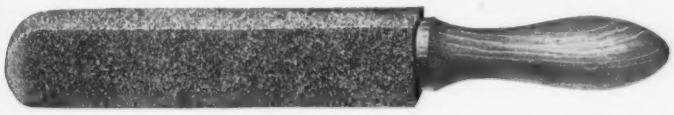
It is not necessary to use key-ways or set-screws to fasten the "Oneida" pulley to the shaft. The hub is so constructed that it grips the shaft securely without danger of slipping. A system of interchangeable cast iron bushing is also used. This allows the pulley to be used on several different sizes of shafting, by merely inserting the correct bushing.

The Oneida Steel Pulley Company offers to send a copy of their new illustrated 48 page catalogue to anyone who requests it.

Carborundum File.

THE Carborundum file continues its work where the steel file is forced to leave off, that is, besides doing all of the work a steel file can do, and doing is better and quicker, the Carborundum file will cut metals which the steel file cannot touch.

The Carborundum file is a solid block of carborundum 13 inches long, 1½ inches wide, and 1½ inches thick. One end is rounded, and the other fitted with a durable wooden handle. For filing castings or soft metals it does the work much quicker and better than the steel file, and for touching up case hardened parts and removing the scale from the harder metals there is nothing to equal it. The Carborundum file readily removes material which the steel file cannot even touch. Incidentally the Carborundum file will outlast twenty steel files.



CARBORUNDUM FILE.

Carborundum is the hardest and sharpest of all abrasive materials. Every little grit or grain in the Carborundum file is just as hard and just as sharp as a diamond, and they cut fast and clean, never wearing smooth and allowing the file to fill or glaze.

In general machine shop work the Carborundum file fills a long-felt want, as it not only does better and faster work than the steel file, but is much more economical in the end. It is made in a convenient size and shape, and of just the proper grit to be efficient in all around work. The Carborundum file can be had from hardware dealers, or from the Carborundum Company, Niagara Falls, N. Y.

Industrial Notes.

—The Industrial Supply and Equipment Company, 407 Sansom street, Philadelphia, Pa., have been appointed sales agents east of Pittsburg for the Brown Automatic Hose Coupling Company, Cleveland, Ohio, manufacturers of the Brown automotic hose coupler.

—"ABC" exhaust fans made by the American Blower Company, Detroit, Mich., are being used for elevating seed cotton on the estate of the Czar of Russia, his plantation being entitled the Imperial Mourgab Estate at Bairam-Ali, Turkestan, Russia. Of this estate, a Mr. Bouchoueff is chief engineer.

—The Triumph Electric Company, of Cincinnati, Ohio, announce a change in address and management of their Chicago office. W. R. Bonhan succeeds F. L. Merrill, as manager, and is located at No. 275 La Salle street, instead of in the Manhattan Building, as formerly.

—The Buffalo Steam Pump Company has recently reopened the St. Louis office in charge of H. H. Downes, 911 Third National Bank Building. Mr. Downes was transferred from the home office at Buffalo, and has had a wide experience with the products of the Buffalo Steam Pump Company, the Buffalo Forge Company, and George L. Squier Manufacturing Company.

—J. G. White & Co., Inc., engineers and contractors, 43 Exchange place, New York, have been awarded a contract by the New York, Ontario and Western Railway Company for the erection of railroad shops at their Mayfield yards, Mayfield, Pa., near Carbondale. The work to be carried out consists of the erection of a ten stall roundhouse, with a 75 foot turntable, machine shop, carpenter shop, with complete power plant, storehouse, office building, oil building, sand storage, drier and loading house, and a complete coaling station with a storage capacity of approximately 1,000 tons. The buildings will be of the usual type of brick and steel construction. The estimated cost is approximately $150,000.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

PLATT IRON WORKS, Dayton, Ohio, U. S. A.—A new and handsome bulletin of 40 pages, illustrating and describing the full line of Smith-Vaile Air Compressors, steam and power actuated. All the standard types and sizes are very fully presented, the designs of compressors for special duty are indicated, and the publication is replete with valuable tabular exhibits. Free on request.

NATIONAL BRAKE & ELECTRIC CO., Milwaukee, Wis.—Publication No. 391, showing National motor and belt-driven air compressors for industrial service.

Blowers.

B. F. STURTEVANT CO., Hyde Park, Mass.—Bulletin No. 175, showing in detail the high-pressure blowers.

L. J. WING MFG. CO., 2111 West Street Building, New York.—A handsomely printed pamphlet, twenty pages (6 x 9), illustrating and describing in detail the construction and operation of the "Typhoon" turbine blower—the simple mechanical device which is working a revolution in power-plant and furnace practice, because it does away with the need of high chimneys, is so small that it can be set in existing boiler walls, and so remarkably efficient that it seems to solve the problem of mechanical draft. Ask for Bulletin No. 7.

Coal-Handling Machinery.

MEAD-MORRISON MFG. CO., Boston, Mass.—Catalogue No. 15, showing coal-handling machinery, electric and steam hoists, grab buckets, derrick swingers, belt hoists and suspension cableways. A great many photographic illustrations are shown, illustrating particular applications of complete coal unloading, storage and reclaiming installations. An examination of these illustrations must offer many suggestions for the successful treatment of handling problems.

Conveyers.

JEFFREY MFG. CO., Columbus, Ohio.—Bulletin No. 42, illustrating many installations of coal handling and mine equipment. Photographs of the conveyors in place form the principal part of the book.

Electric Hoists.

PAWLING & HARNISCHFEGER, Milwaukee, Wis.—Bulletin No. 18, showing photographic illustrations of traveling electric hoists designed and built for various classes of service.

Electric Welders.

TOLEDO ELECTRIC WELDER CO., Cincinnati, Ohio.—An illustrated catalogue showing the Toledo electric welders for welding iron and steel, copper and brass, rods, pipe, bar stock, etc.

Engines.

RIDGWAY DYNAMO & ENGINE CO., Ridgway, Pa.—Bulletin No. 22, illustrating the parts of the Ridgway four-valve engine, built in simple, tandem compound, and cross-compound types.

Leather Specialties.

DETROIT LEATHER SPECIALTY CO., Detroit, Mich.—Folder entitled "Why," telling why "Wear-Well" leather packings are of long life, with special reference to "Mercury," a new leather particularly adapted to packings for hydraulic and compressed-air machinery.

Power-Plant Appliances.

LIBERTY MFG. CO., 6910 Susquehanna Street, Pittsburg, Pa.—A set of bulletins, illustrating tube cleaners, blow-off valves, strainers, oil purifiers, separators, feed-water regulators, etc.

Pumps.

BUFFALO STEAM PUMP CO., Buffalo, N. Y.—Catalogue No. 228, illustrating and describing in detail Buffalo vacuum pumps, jet, barometric and surface condensers of every description for all requirements.

Steam Engines.

TRENTON ENGINE CO., Trenton, N. J.—Catalogue R, describing the Reeves engines for belted and direct connection. Particular attention is directed to the new type side crank, vertical, cross-compound engine and the new type of side crank, horizontal single-cylinder engine.

Steam Specialties.

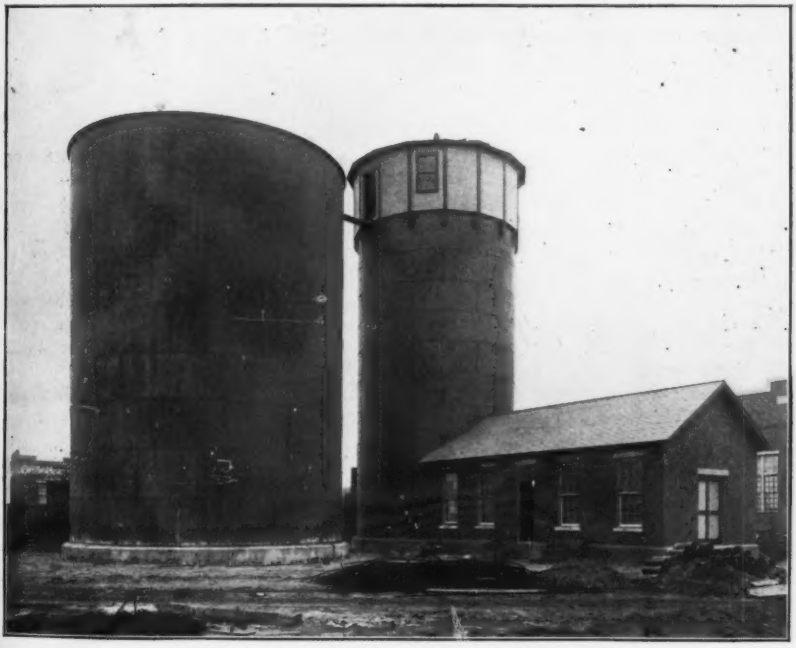
WRIGHT MFG. CO., Detroit, Mich.—Catalogue No. 12, illustrating the Wright steam specialties, including high and low-pressure steam traps, safety alarm water columns, exhaust heads, filters, air traps, etc.

THE CURRENT RECORD OF
IMPROVED MACHINERY
NEW METHODS NEW MATERIALS
NEW APPLIANCES

Largest Water Softener.

THE accompanying illustration shows a Booth water softener of a capacity of 40,000 gals. an hour built in connection with the new roundhouse and shops of the Vandalia Railroad Co. at Terre Haute, Ind., by L. M. Booth Co., 136 Liberty street, New York. This softener is the largest plant of the kind ever installed, power being furnished by an overshot water-wheel at the top of the softener, all of the working parts, including feeding apparatus and regulating equipment, being placed in a substantial brick structure at the ground level.

Abandoning rule of thumb methods in water treatment L. M. Booth Co. have reduced the subject to a problem in chemical engineering capable of mathe-



BOOTH WATER SOFTENER AT TERRE HAUTE, IND.

matical solution. They are thus able to guarantee definite results at a definite cost.

The theory of the process in ordinary cases is comparatively simple, but its success depends chiefly on the efficiency of the apparatus used to carry out the operation. That a well-designed and accurately constructed apparatus is essential to satisfying results will be apparent when the fineness of the result sought is pointed out. There are on the market few products running as high as 99% pure, and those that run 99 9-10% pure are extremely few. The starting point in water softening is even above this limit. A water which contains 14 to 15 grains of scale forming material to the gallon is hard water, yet this amounts to only one-fortieth of one per cent of impurity.

The L. M. Booth Co. publish a pamphlet, "Hard Water Made Soft," which contains much interesting and instructive information on water-softening. It will be sent free on request.

"Industrial" Dial Type Thermometers.

THE principle and construction employed in the "Industrial" thermometer make the calibration permanent, the system being absolutely sealed. It can be made in the various stem types now in use as well as the long distance type, in which the bulb is placed at the best point for taking temperatures and the dial at the most convenient point for reading them. The effective working scale is very long (about 300 degrees of a circle, or 13 inches on the 5 inch dial). It has conspicuous figures and divisions that may be read from a distance—no effort, inconvenience, or error as in reading mercurial thermometers. The form of scale is such that if the proper range is selected the working part of the scale is remarkably open and effective. The utmost sensitiveness is obtained by inserting the bulb, which is made of copper—a good conductor—directly into the fluid.

The pressure exerted by the vapor of an enclosed liquid is proportional to the temperature. In the "Industrial" thermometer, therefore, a small copper bulb is partly filled with the fluid (the kind depending upon the range) and connected by a fine bore copper tube of any desired length to a pressure gauge, which

INDUSTRIAL DIAL TYPE THERMOMETER.

is graduated to read direct the temperature of the bulb, in degrees Fahrenheit, Centigrade or Reaumur.

Changes of temperature at the case or in the connecting tube do not effect the reading of the instrument when the bulb is at a higher temperature since the vapor tension is due to the temperature at the surface of the liquid, *i. e.*, in the bulb. Neither do barometric changes have any appreciable effect since they are negligible in respect to the total working pressure of the system.

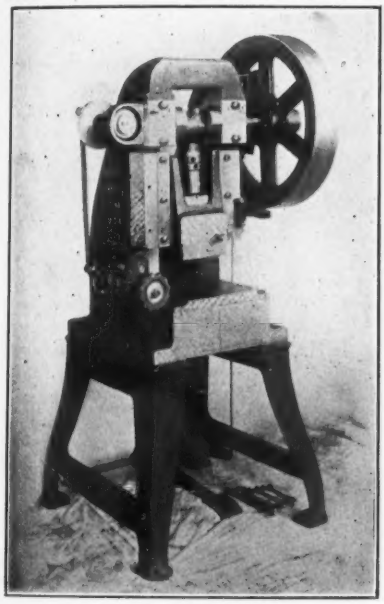
Some of the obvious uses of these thermometers are for feed water, mash tubs, vulcanizers, vacuum pans, dry kilns, cookers, rendering tanks, kettles, or in any open or closed vats, tanks, or pipes, containing gases, liquids or air, the temperature of which should be accurately known or controlled.

The "Industrial" Dial type thermometers are made in all sizes from 2½ inch to 12 inch dials and for any ranges from

50 to 500 degrees Fahrenheit. The stems may be made for practically any convenient length either bottom or back and the tube type can have the dial about 300 ft. from the bulb if necessary.

"Baird" Transfer Presses.

THIS press is a new design specially built for heavy blanking and stamping. It is furnished with seats or pads so that a plain press can first be obtained, then attachments later, which



BAIRD TRANSFER PRESS.

can be easily applied without necessity of shipping the press to the factory—a feature peculiar to "Baird" presses. The transfer attachment takes the place very largely of work commonly done in a cut and carry press, but is very much cheaper in first cost and up-keep, as but one set of side tools is required, and the degree of accuracy is not required in transfer tools as with a set of cut and carry tools. The automatic stop furnished with this attachment positively stops the press should the blank for any reason not be transferred to its proper position, which is a feature that saves many dollars of damage to tools.

The open back press is furnished either with a side or back roll feed, which can be adjusted to feed the metal in either direction by simply throwing a pawl over the center. The lifting pin attachment is for raising stamped articles out of the die to facilitate their being knocked off. The friction dial attachment can also be supplied with a positive stop which stops the press automatically should the dial fail to turn to its proper position, saving damage to the goods.

Attachments can also be specially designed for the purpose. These presses are finding a ready market among jewelry, novelty, brass and steel goods manufacturers, and are found to be a very handy press, on account of its universality. Full and detailed information can be obtained from "Baird" bulletins 202 and 204, copies of which can be obtained from the builders, The Baird Machine Company, Oakville, Conn.

Farwell Gear Hobber.

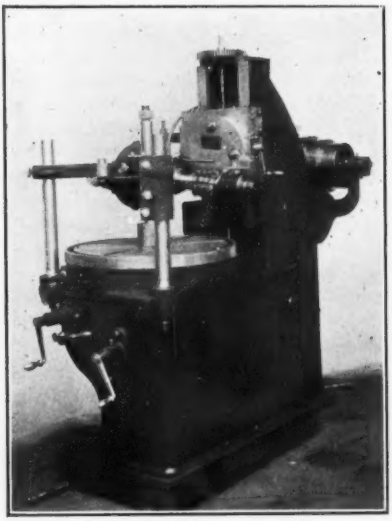
THE accompanying illustration shows the No. 3 Farwell gear hobber. This machine is much heavier than the Farwell No. 1 and is designed for handling work up to 24 inches in diameter, 3 P., cutting 12 inches of face at a time.

The head saddle has an unusually long bearing upon the housing. The spindle has no unnecessary overhang, has adjustable bronze bearings of ample size and length and is very rigidly secured to the saddle. The compact and rigid design of the spindle support has been a feature of the Farwell gear hobber.

On account of handling coarser pitches than the No. 1 machine, this new tool is provided with a slide in the saddle that carries the hob, making it possible to adjust the hob spindle longitudinally, bringing any tooth exactly central with

the work arbor. This is quite important in obtaining perfect gears in coarse pitches, but does not require attention on fine pitches, as the difference in position of two succeeding teeth is not sufficient to be noticeable in the gears.

This longitudinal movement of the spindle head permits also the shifting of the hob to a new cutting position without resorting to moving the hob or the



FARWELL GEAR HOBBER.

arbor. Several shifts may be made, bringing sharp cutting parts of the hob into action before it is necessary to grind the hob.

The head has an automatic trip to stop the downward feed, and is also equipped with a power mechanism for raising the head after the cut is finished. The head, of course, returns but once for each stack of gears and on the small machine this operation is performed by hand. There are two extra feeds on the No. 3 machine, making ten, all of which are obtained in the gear box. The horizontal feed mechanism for cutting worm wheels is incorporated in the design of the machine, and supplied without extra charge, as is also the special support for upper end of arbor. This arbor support is only necessary when gears must be swung on centers, for wide face gears or in cutting a stack of gears of small diameter. A more rigid support can be secured in other cases by the use of face plates, or supporting rings which rest upon the table and support the blanks immediately below the rim.

The spindle is driven by a bevel gear instead of a belt, as the coarser pitches necessitate tilting the hob to a greater angle than the belt drive, as used on the No. 1 machine, would allow. This angle and the tooth depth are set with a hardened steel gauge as on the smaller Farwell gear hobber.

All important bearings have bronze bushings and the spindle and arbor bearings may be adjusted by simply loosening a lock ring and tightening an adjusting ring nut.

The design of the base and column of this machine is exceptionally rigid, one casting forming both, as well as the knee below the table and an oil pan around the machine. The weight of the machine is about twice that of the No. 1 hobber, or over 2,000-lbs.

A large tank to hold lubricant is enclosed in the base, and ample passages through the hub are provided to conduct the lubricant from the table back to the tank. The lubricant pump is gear driven and has means for regulating the flow of lubricant.

All gears are provided with shields, as is also the universal joint shaft. The builders, the Adams Co., 621 Bridge Avenue, Dubuque, Iowa, will furnish full details on request.

Industrial Notes.

—Garwood Electric Company have appointed George F. Herrig Company of Saginaw, Michigan, as their agents, their territory being Saginaw, Michigan, and all territory within a radius of fifty miles of Saginaw.

IMPROVED MACHINERY

NEW METHODS NEW MATERIALS
NEW PROCESSES NEW APPLIANCES

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Automatic Reversing Trippers.

NEW YORK, January 22, 1911.

To the Editor,
The Engineering Magazine.

DEAR SIR:—

Our attention has just been called to an article on Page IX of your department of Improved Machinery for January, describing and illustrating an automatic reversing tripper which, according to the article, is made by the Stephens-Adamson Manufacturing Co. of Aurora, Ill.

This machine is described as a "new" automatic reversing tripper. Your article contains such a full and detailed description of the mechanism that we are able to say with certainty that the device infringes every one of the twelve claims of our Patent No. 673,539 of May 7th, 1901, covering a tripper invented by the late Mr. James Barnes Humphreys, who was for several years the chief engineer of this company. We ask you to examine the picture and description of the tripper referred to in your article and satisfy yourself that there is not a single mechanical detail which is not fully shown and described in our patent of ten years ago, which we send herewith.

Our company has built hundreds of trippers under this patent, every one of which is plainly marked with the patent number. We have also had full sized machines of this type operating at all of the large World's Fairs since the Paris Exposition of 1900, where we received the only Grand Prix which was awarded for conveying machinery. Furthermore, this same tripper is illustrated and described fully in our earlier catalogues. Therefore, we are compelled to attribute to audacity rather than to ignorance, the claims made by the Stephens-Adamson Company in your pages that they are offering a "new" automatic reversing tripper, and that "there has been a great need in certain classes of work for a tripper of this sort."

Several years ago our company discontinued, to some extent, the use of the friction drive for moving the tripper, and substituted wherever it was possible a mechanical equivalent which is absolutely dust-proof, thereby saving our customers the expense of renewing the friction wheels. But the fact that we do not commonly employ a mechanical detail which was tried and found wanting, offers no excuse for any one to use your pages in order to foist upon the public as original and new, a device which has been patented for ten years in every civilized country on the globe, and which has been advertised and sold in large numbers by the most prominent concern in its line of business.

The matter of infringement of our rights is one which we can look after with the help of our attorneys; but the damage, and particularly the annoyance, which we shall suffer from the article in your journal are serious matters. We are sure you will agree that such an article breeds other infringements, and

attracts trade away from those to whom it rightfully belongs. We therefore trust that you will give this letter as much prominence as was accorded in your columns to the article to which we have made objection.

Yours very truly,
ROBINS CONVEYING BELT CO.,
Thomas Robins, President.

The Fort Wayne Rock Drill.

THE Fort Wayne type "A" electric rock drill is the result of several years development and testing under the most severe and unfavorable conditions of actual working operations. Contrasted with designs making use of flexible shafts, solenoids, springs and other complicated devices, the Fort Wayne drill is unusually simple, and consequently it is exceedingly rugged and effective.

This drill is of the rotary hammer type, operated by an electric motor which is mounted on the frame of the drill proper. The mechanism of the drill consists of two parts, a revolving helve containing the hammers, and the chuck mechanism for holding and rotating the drill steel. An idler is conveniently arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus all the advantages of hand drilling are obtained without the disadvantages usually incident to machine drilling.

The drill steel is held in the chuck by means of several spring steel plates. When not striking rock, the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground.

The drill casing, striking mechanism, chuck and buffer plates are all simple and very substantial. The floating hammers in the helve are of special steel and are completely cushioned by air chambers so that the jar of the impacts is reduced to a minimum.

The drill steel cannot be jammed into a fissure or cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge, it has hammered for itself a square shoulder or face, due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring.

Another point of excellence in the

Fort Wayne drill is the simple method employed for the removal of cuttings from the hole being drilled. A special designed steel removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the big item of pressure systems, including tanks, hose, water lines, etc., is eliminated, as well as the cost of maintenance and inconvenience incident to such systems.

While these drills are ordinarily used in a horizontal position, they can be used in any position and will drill holes at any angle.

The ease with which power can be transmitted throughout the workings by wire, and the rapidity with which the lines can be changed, enables the operator to advance his work more rapidly than could be done when using other types of drills. A comparison of tests of the type "A" drill and air drills shows that the former requires about 1½ to 2 horse power, including transmission loss, while an average air drill requires from 12 to 18 horse power for the same work. This is due to the design of the drill, the much greater efficiency of the electric motor, and the small loss in transmitting power to the drill. The simplicity and ruggedness of design of the type "A" drill is a guarantee that the cost of maintenance will be exceedingly low. Owing to the saving in power, the low cost of maintenance and the high efficiency of the Fort Wayne drill, from 50 to 70 per cent. can readily be made, under ordinary conditions, upon the investment.

The drill can be operated with either an AC or DC motor and since the motor is entirely independent of the drill the change from one to the other is easily made.

Bulletin No. 1120 issued by the Fort Wayne Electric Works, 1630 Broadway, Fort Wayne, Ind., illustrates and describes this drill in detail. It is sent free on request.

Automatic Fuel Oil Regulation.

PRACTICALLY all oil fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner, and the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant.

The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Co., Los Angeles, Cal., where under the directions of the chief engineer, one man stationed near the oil pumps, running at practically constant speed, controlled 18 boilers or 54 burners by opening or closing a bleeder valve on the oil pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore automatic fuel oil regulating system. This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners, and the supply of air for combustion, for any number of boilers, all from a central point. The results are increased boiler plant efficiency, the practical prevention of smoke, and the decrease in the maintenance cost of boiler equipment, due to a more uniform manner of firing. This was first installed at the Redondo plant of the Pacific Light & Power Co. in 1907. Here the regulating system is used to control the entire plant of 18 boilers of 600 horse power capacity each, and the increased economy, due to uniform rate of firing, is very evident.

Under actual operating conditions this system of regulation has been found absolutely reliable. In 1909, or about two years after this apparatus was installed, A. C. Balch, general manager of the Pacific Light & Power Co., expressed his opinion in the following letter to the designers:

"As you know, we have in our plant at Redondo, 18 Babcock & Wilcox boilers, each rated at 604 horse power, with three burners per boiler, or 54 burners in all. The entire boiler plant has now been equipped with the Moore automatic fuel oil regulators for the past year, which control the steam pressure, the fuel oil pressure, the supply of steam to burners for atomizing the oil, and the operation of boiler dampers for the purpose of regulating the supply of air for combustion.

"With this system we maintain practically a uniform pressure while in operation. One-third of the plant has been under automatic control for a period of over 18 months. The remainder as stated above, was equipped with your regulators one year ago and the entire plant is now operating under this condition. During this time we have never suffered an interruption of service, or loss of steam pressure, due to failure of regulators to operate; they are simple in design and positive in action and we find them capable of ready adjustment by the operative firemen.

"Our plant is subject to a widely swinging railway load and we find under all conditions the boilers respond to these fluctuations of load almost instantly. As the result of installing this equipment we find the load is more equally divided among all of the boilers in service than under hand firing, and the boilers are free from abuses due to excessive rate of firing periodically experienced with hand regulation on variable load.

"It is usually the case, in attempting to hand regulate fires on reduced air supply, that the chimneys will smoke frequently on variation in loads; as a result of the automatic system of regulation, the smoke nuisance has been reduced to a minimum."

At this time, 1911, after this system has been in operation a number of years, the Southern California Edison Co. is installing a similar outfit. A bulletin "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them," can be obtained on writing to Chas. C. Moore & Co., San Francisco Cal.

Eight Spool Caisson Hoist.

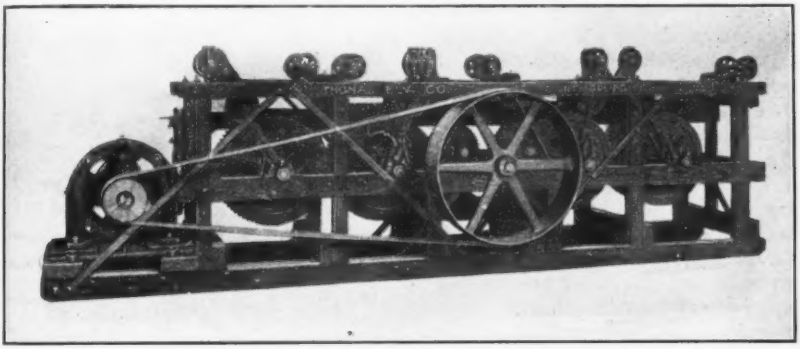
UP to the present time hoisting from caissons has been done with the ordinary hoisting engine equipped with governor and cable driving sheaves. A spool is located at each caisson and an endless cable is carried from the hoist sheave around the several caisson spools operating them in series.

With this equipment it is necessary that the caissons be either aligned or that a combination of sheaves be installed to spring the cable to the proper direction. In this installation a fouled line at any caisson stops all work on the series until the line is straightened or repaired. It not infrequently happens also that the driving cable breaks, with the result that all buckets are precipitated to the bottom and often injuring the workmen. There is another disadvantage in the fact that in the usual work only a part of the caissons are completed at one time and a portion of the plant and workmen must remain idle while the remaining caissons are being finished, or the hoisting from the incompleted caissons must be done by hand.

The improved caisson hoist, shown herewith, obviates all of the above difficulties. The material from each caisson is hoisted independently. There is no

necessity for alignment of caissons as the machine provides a separate hauling line to each caisson and operates with equal facility in any direction. A caisson located at any place in the foundation therefore can be started at any time desired.

Since each caisson is operated independently, any breakage or cessation of work does not interfere in any manner with the progress in the other caissons. A slow or difficult caisson, also, does not impede the work in the other caissons.



Any hoist speed of load may be had from 0 to 150 feet per minute and the speed is under the absolute control of the operator at the caisson. An accident in any line, therefore, will not affect any other. The hauling line is so carried that it does not slip on a spool and burn out; the slippage is entirely on a friction disc, built for the purpose, and the line and frictions are therefore practically indestructible.

One set up on any ordinary size building is sufficient to complete the job. Caissons located as far as 100 feet radius can be operated with ease.

This hoist is made by Thomas Elevator Co., 20 South Hoyne avenue, Chicago, Ill., who will furnish full information respecting it on request.

Durability of Metal Roofs.

MANUFACTURERS are daily giving more attention to the minimizing of factory costs and the costs of maintenance and general factory wear and tear, and for years big manufacturers have been looking for a roofing material that would stand the exposure to the smoke and grime-laden atmosphere of manufacturing districts. A number of the larger plant owners in various parts of the country are using Toncan Metal, a rust-resisting product made by the Stark Rolling Mill Company of Canton, Ohio, in the roofing of their plants. Among the large factories in the country which have replaced old rust-eaten, corroded iron and sheet steel roofs with Toncan Metal are the Union Rolling Mill Company of Cleveland, Ohio; Ball Brothers, glass manufacturers of Muncie, Ind., and the Seneca Chain Company of Kent, Ohio.

Durability is the chief requisite in a metal roof. It costs thousands of dollars to cover acre after acre of factory roof with steel and iron that offer little resistance to adverse weather and other conditions which work toward early rusting and corrosion. It has been the experience of many that roofing material has had to be replaced yearly. The Union Rolling Mill Company is one of

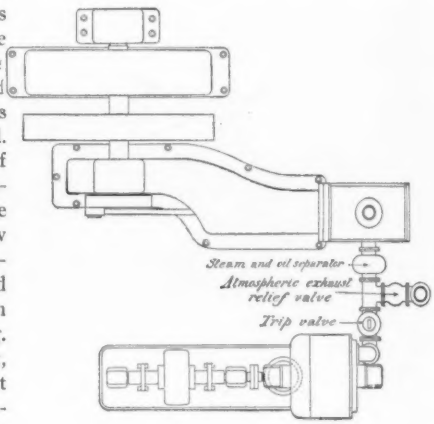
the largest concerns of its kind in the country. In 1907 they adopted Toncan Metal for roofing purposes, 1,300 squares or 130,000 square feet being placed on the factory roof during 1907, 1908, 1909 and 1910. Previous to that time it was necessary to replace portions of the roof on an average of once a year, but since the first installment of this new metal roof it has not been necessary to replace any of it. The roof is as good to-day as it was the day it was put on, because the weather conditions and the sulphurous conditions arising from the mixture of smoke and fumes do not corrode it as did the roofing material previously used.

The Seneca Chain Company, one of the largest chain manufacturing concerns in the world, is erecting a large plant at Kent, Ohio. In erecting a new plant to replace the one recently destroyed by fire, they specified and used Toncan Metal for roofing and siding on the entire plant. The Ball Bros. Mfg. Co., at Muncie, Ind., one of the largest, if not the largest manufacturers of fruit jars, has found it economical to use Toncan Metal sheets not only for roofing and siding on their immense plant but also in connection with their manufacturing operations.

Steam Turbines With Reciprocating Engines.

TO increase the power of a plant where the requirements have slightly outgrown its original capacity is a trying problem that is often made easy by means of the exhaust steam turbine. This is well illustrated for instance in a mill deriving its power from a simple non-condensing engine, and in which the addition of machinery from time to time has increased the load on the engine beyond a practical limit.

Changing the engine to condensing and utilizing the additional range of pressure drop to drive an exhaust steam turbine, not only almost doubles the amount of power previously secured from the engine, but this is done without increasing the duty on the engine and without using more steam than before. Such an installation is illustrated herewith. The initial cost of the turbine and condenser

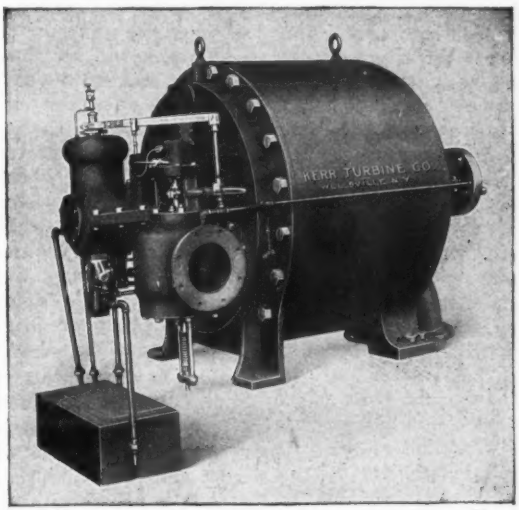


per horse power is less than for additional boiler and engine capacity, and there is not the compulsion to buy more than may be required.

The second illustration shows a Kerr exhaust turbine, made by Kerr Turbine Co., Wellsville, N. Y. This machine operates with any steam pressure above 2 pounds gauge at its inlet and exhausts into a vacuum of from 24 to 28 inches utilizing exhaust from main engine, pumps, air compressors, etc.

The installation of such an exhaust turbine improves the economy most and offers the greatest capacity increase where the turbine and a suitable condenser are added to a simple non-condensing engine. For the smaller sizes the ordinary jet condenser maintaining

24 to 26 inches vacuum may be used with satisfaction. In larger units condensing apparatus maintaining higher vacuum is justified. A substantial improvement in economy and increase in capacity also result from the addition of an exhaust turbine to a simple condensing engine and from the addition of turbine and condenser to a compound non-condensing engine.



In general the steam economy of a simple engine and exhaust steam turbine together is always an improvement over that which would be obtained by compounding and adding a condenser. The plant capacity is increased from 50 to 100 per cent. by exhausting through an exhaust turbine to condenser on a non-condensing engine, while the increase by adding the turbine to a condensing outfit is from one and one-half to three times that which could be secured from the condenser alone.

As an engine and exhaust turbine installation takes no more steam than would the engine alone and under the same conditions as before, there is not an additional penny of expenditure necessary for boilers, chimneys, draft, coal handling apparatus, buildings and steam piping. The turbine and condenser, or turbine alone in a condensing plant, can be cut into the exhaust line without interfering with the engine and usually without otherwise altering the layout of the plant. The installation of the turbine hardly affects plant operating costs as the turbine is adjusted at the factory and seldom requires other attention than occasional lubrication and repacking of stuffing boxes. The oiler who has previously been taking care of the engine can look after the turbine too without any serious drain on his time, for the turbine should run constantly for months without shutdown.

An engine that has previously been running non-condensing, continues to exhaust at about the same pressure and carries the same load after the turbine

is put into the exhaust line. A condensing engine can be adjusted to exhaust at atmospheric pressure or thereabouts and will be relieved of that part of the load assumed between atmospheric pressure and the vacuum while the turbine is being operated. The water of condensation will be discharged from the condenser at a temperature within two or three degrees of the theoretical and can be utilized in the usual ways.

In short, the increase in output obtained from a condensing reciprocating engine and exhaust set is greater by about 25 per cent. than obtainable with any condensing engine alone while the installation of turbine and condenser upon a non-condensing engine increases the output from about 40 to 100 per cent.

Power developed by an exhaust steam turbine is available for driving a generator, centrifugal or air pump, fan or any high speed machine or for belt or silent chain driving, and under much the same conditions as that obtainable from high pressure turbines. Rigged up for belt or chain drive, the exhaust turbine delivers into the same line or jack shaft as the engine, in which case the turbine assumes an almost fixed proportion of the load. Figure 3 is a typical installation of this kind. The output of the turbine may be delivered entirely independent of the engine to drive belted auxiliaries or machinery of any kind, the speed requirements of the driven machine being perfectly met by a conforming pulley ratio.

Cameron-Ingersoll-Rand Consolidation.

THE recent change in the proprietorship of the A. S. Cameron Steam Pump Works from the widow of the founder to the Ingersoll-Rand Company has excited a good deal of attention and some misunderstanding. As a matter of fact the Ingersoll rock drill and the Cameron pump have always been very closely associated, each being about the same age, forty years. In a little shop on the corner of Second avenue and Twenty-second street, New York, both the Ingersoll drill and the Cameron pump originated, and for some years the manufacture of both took place under the same roof. The late Henry C. Sergeant designed the first really successful Ingersoll drill, getting his fundamental ideas of the valve motion from A. S. Cameron This was at a time when even the flywheel engine was more or less of a novelty, and a reciprocating engine, like a pump or rock drill, with no crank shaft to carry it around the center, was practically unknown. The first machines of this class were built on steam engine lines, the valve itself being mechanically connected with the piston. In the first Ingersoll drill, as in the first pump, when the piston reached the end of the stroke it reversed the valve by direct mechanical contact with knuckle joints, rods or other devices, which intervened between the piston and the valve.

Here is where great credit is due to A. S. Cameron. He was seeking to perfect a pump which should be used in rough places where exposed parts were liable to wear and injury. He also wanted to build a valve which would open up a large port at the end of the stroke at the instant that the piston reached a certain point. This was hardly practicable with a mechanically moved valve without excessive shock and wear. Cameron's invention, therefore, was to place a small tappet or knuckle in each cylinder head of the pump, which would serve as a trigger to trip through contact with the piston and open a small port connecting either end of the valve. The valve itself was submerged in live steam pressure equal at both ends, hence when this tripping action took place it reduced the pressure on one end so that the active

pressure on the other caused it to reverse. In order to do this with the minimum shock at the tappet, or with a small trigger action, and also taking into consideration the importance of having a small port controlled by such action, Mr. Cameron used a plunger piston which in turn overlapped the valve itself, this plunger piston having an area on each end which might be greater or smaller according to the resistance of the valve to the action of sliding on its seat. The valve itself was, and still is, a slide valve which, as everybody knows, rests tightly upon its ports and does not leak by wear.

Sergeant had a problem more difficult than Cameron, because, in the first place, the speed of a pump is only about 100 feet per minute, while that of a rock drill is four times as great. This high speed made it difficult to use any kind of a tappet trigger, and in order to get the quickest action of the valve, Sergeant sought to obtain the slide valve and to use the plunger or valve moving device of Cameron as the valve itself. In doing this he ran against another difficulty;—the valve, in order to be tight on its seat, would press so hard that the speed of the drill became sluggish. To overcome this he ran a bolt through the center of this valve, which relieved it of a certain portion of this pressure. Instead of the tappet trigger Sergeant moved his valve by causing the piston of the drill to uncover passages leading to each valve end. Here we have the identical principle, so far as the valve movement is concerned, that is embodied in the Cameron pump, namely, an equal pressure on both ends of the valve and the valve moving through a disturbance of that pressure on one end and the other alternately, the action itself being controlled by the strokes of the piston. No better evidence is needed of the success of this valve action than the fact that the Ingersoll "Eclipse" drill and the Cameron pump are at work today with valves of this construction.

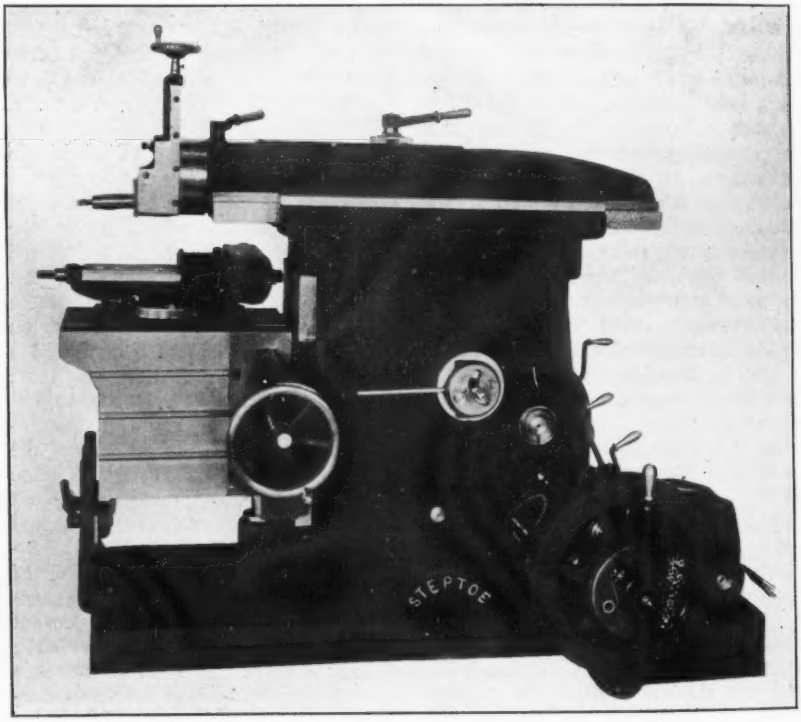
The community of interests between Cameron and Ingersoll has extended from this inception to the present day. The castings for the first air compressors of the Ingersoll make were made in the Cameron foundry on East Twenty-second street. For many years, and until the Ingersoll works were moved to Easton, Pa., the castings were made by Cameron. The success of the Cameron pump in mines, quarries and for contractor's service, brought it close to the Ingersoll business. In South Africa, and other places, the Ingersoll-Rand agents have been the agents for the Cameron pump.

Adam Scott Cameron graduated from Cooper Institute and applied himself to mechanical matters. He was engaged in building the Sewell and Cameron crank and flywheel pump, which during the Civil War was in demand by the United States Navy and the Merchant Marine. At the close of the war the call for these pumps fell off so that Mr. Cameron turned his attention to the design of a pump of greater adaptability and more general application. The standard Cameron pump was the result, its acorn-shaped air chamber, the emblem of the clan Cameron, the oak, being his trade mark and continuing up to the present time. He died at an early age, but he had stamped his ability and force of character upon the mechanical engineering of his age. His widow carried on the business up to a recent date, the management being for the past eleven years in charge of George Ward Fuller, to whom much credit is due for the successful introduction of the Cameron pump throughout the world. Mr. Fuller continues as vice-president and general manager of the company; George Doubleday, who is first vice-president of the Ingersoll-Rand Company, being president, and the direc-

torate being composed of Mr. Fuller and the directors of the Ingersoll-Rand Company.

Motor Driven Crank Shaper.

THE accompanying illustration shows a new motor driven crank shaper with speed box, made by the John Steptoe Shaper Co., Jessamine Station, Cincinnati, Ohio. The drive consists of a small gear on the motor with a large gear on the speed box shaft. Four changes of speed are secured through the speed box, and by means of the back gears, eight changes are secured.



The machine can be stopped or started by means of a clutch which operates in the hub of the large gear. One pound pressure on the clutch lever gives 128 pounds pressure on the ring, so that the machine can be started or stopped almost without effort on the part of the operator. It can be operated by means of the thumb and first finger of the right hand. All of the clutch mechanism is fully enclosed, thus avoiding the possibility of the operator getting caught, and doing away with the possibility of accidents.

All the bearings in the speed box are equipped with ring oilers, which keep the shafts constantly flooded in oil. Spiral oil channels are chased in the shaft to insure the proper distribution of the oil

over the entire bearing. The speed box is so arranged that no clutches are used, and there are, therefore, no gears running idle on the shaft, avoiding any possibility of noise or wear on the hole in the gears. When one gear is shifted in position, the other is shifted out, thereby making a very effective drive, and reducing the wear to a minimum. The only wear on our gears is when they are in actual operation, and all gears are keyed to the shaft.

The motor used is a General Electric 3 horse power, constant speed, running about 1,200 revolutions per minute.

A large bush is provided where the driving shaft from the shaper enters the speed box. This bush enters the column of the shaper and also the speed box bearing. The driving shaft is therefore relieved of any possible strain that might come from the speed box, as such strain would come directly on the bush provided for that purpose. This bushing is provided with ring oilers both in the column of the shaper and in the speed box. The intermediate shaft in the shaper is also provided with ring oilers and bushings, which can be readily removed and replaced at any time should it become necessary. The speed box is supported by means of a heavy brace, projecting from the base of the shaper.

This drive is so simply constructed, that there is nothing on it which can get out of order. The motor is set on a subbase, which is cast onto the base of the shaper. The motor is therefore set on a very solid foundation, and avoids the possibility of shaking the machine when running, thereby preventing chatter marks on the work which is being planed.

A Large Pumping Contract.

ONE of the largest contracts for pumping machinery ever placed has been awarded to the Alberger Pump Company of New York City by the Bureau of Yards and Docks, the total sum involved being slightly over $323,000. The contract covers pumping equipment for the three new dry docks to be constructed by the Government at New York, Puget Sound and Pearl Harbor Navy Yards, and include all told eleven 54 inch vertical volute pumps, each direct connected to a 550 horse power induction motor, and seven 15 inch vertical volute drainage pumps, each direct connected to an 85 horse power induction motor; also all necessary suction and discharge piping, electrically operated gate valves for the same and all electrical controling apparatus for the motors. Three of the 54 inch units will be located at New York, while four of these units are required for each of the other docks.

Each unit is required to operate against a static head, varying from zero when the dock is full to a maximum of 42 to 44 feet when the dock is completely empty, while operating at a constant speed of 219 revolution per minute without exceeding the rated horse power of the motor at any point. In addition to this each pump is required to maintain an average capacity of 66,000 gallons per minute when emptying the dock from approximately mean high water to one foot above the elevation of the keel blocks, the static head varying from zero to 32 or 34 feet. Under these conditions the contractor has guaranteed an average efficiency of 45 per cent. for New York and Pearl Harbor and 46 per cent. for Puget Sound, these efficiencies being the ratio of the actual useful work in pumping the docks to the electrical input to the motors, and consequently include all losses in the motors, pumps and piping. To meet these average efficiencies it is necessary for the pumps, themselves, to reach a maximum efficiency of nearly 80 per cent.

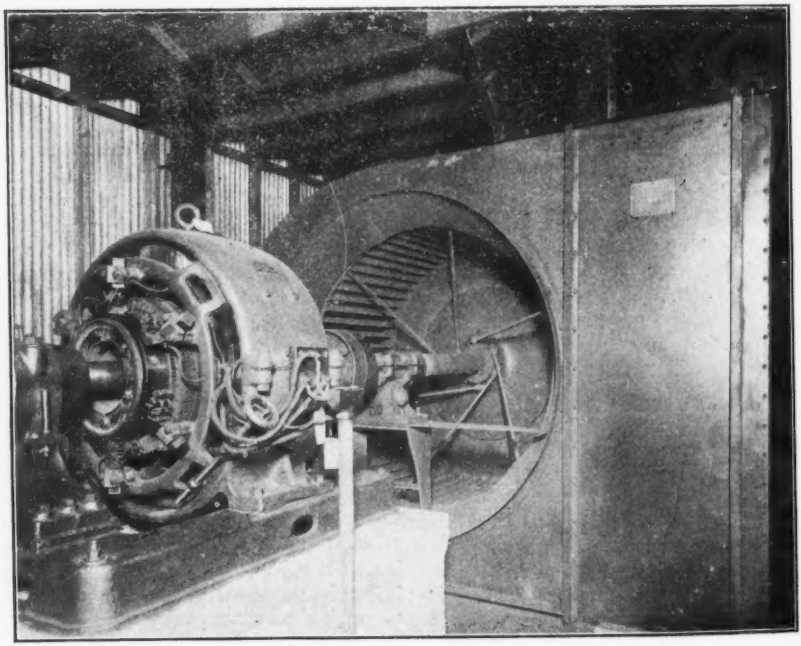
In addition to obtaining a high efficiency, the other characteristics of the pump have to be very carefully determined in order to meet the special conditions involved in this class of work. In fact but few concerns in this country are equipped with the necessary engineering data and experience to undertake work of this character.

Tunnel Ventilation.

ABOUT two months ago, the Hudson & Manhattan Railroad installed at their Washington street power house, Jersey City, N. J., a large double inlet "Sirocco," full housed exhaust fan, for the ventilation of the Hudson Tunnels in that vicinity. An illustration of the outfit is given above.

This apparatus consists of a No. 13 double inlet "Sirocco" full housed fan, with blast wheel 78 inches in diameter by 78 inches wide at periphery, containing 64 blades. Direct attached to the fan shaft by means of a flexible flanged coupling, is a 40 horse power Sprague, slow speed type motor, wound for 600 volts, direct current. Normal speed 175 revolutions per minute, maximum speed 200 revolutions per minute.

The outfit was erected in an air-tight room, the air being exhausted from the tunnels through air-ways and shaft provided for the purpose. There are no connections or ducts between the fan inlets and the air shafts, the air velocity being produced by the suction head maintained in the fan room.

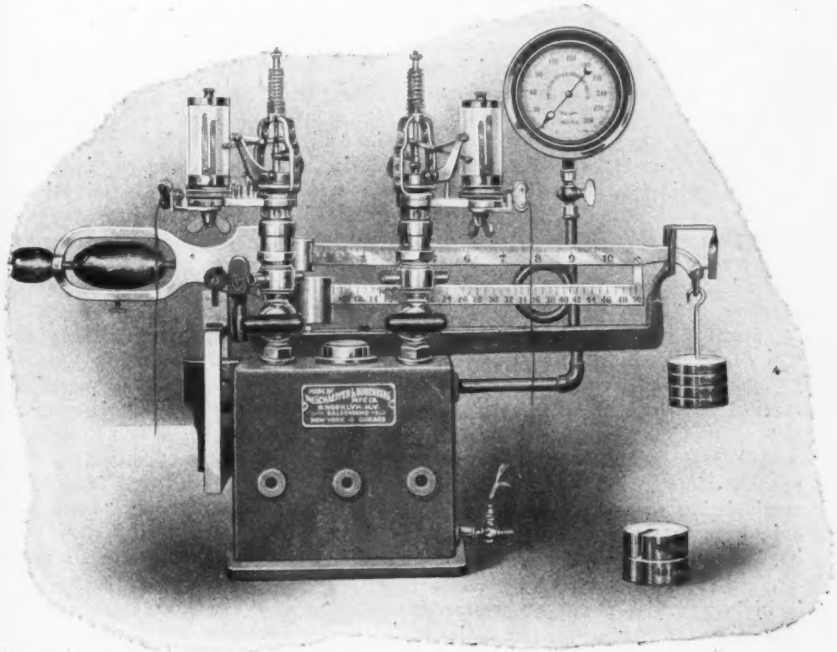


The fan discharges through an evase stack having a screened outlet hood, similar to those used on mine ventilating fans. The fan was required to exhaust from the tunnels 6,000,000 cubic feet per hour, or 100,000 cubic feet per minute.

Determining the Accuracy of Indicator Springs.

THE indicator is unquestionably the most necessary instrument for the operating engineer. The indicator diagram is the only means to ascertain the action of the steam in the engine cylinder, to determine the efficiency of an engine, and to detect internal wastes. It is, therefore, of vital importance that the indicator be absolutely accurate in its performance, which applies especially to the piston spring, the most essential part of the indicator, unless the exact tension of the spring is known errors will result from its use, and the determinations made with the indicator will be of little or no value. The need for a reliable instrument for testing indicator springs has been filled with the apparatus illustrated herewith.

This apparatus, which is made by the Schaeffer & Budenberg Mfg. Co. of Brooklyn, N. Y., consists essentially of a closed vessel made of cast iron, capable of resisting internal steam pressures up to 200 pounds per square inch. The steam pressure in the vessel is measured by a gauge of special construction consisting of a piston of one-half square inch area and which is free to move in an inclosing cylinder.



The lower portion of the piston is

pointed and rests in a yoke which is suspended on the knife-edge of a pair of scales mounted on top of the closed vessel. If the scales are previously balanced, before admitting steam into the vessel, it is evident that the reading of the scales will give the pressure acting on each element of the vessel equal in area to that of the piston. The scales are graduated to fiftieths of a pound which permits of very close readings.

In testing indicator springs steam is turned into the vessel to gradually warm it and allowed to blow through the connections and indicator cocks to remove any particles of dust or grit which may have accumulated there. Shut off steam again and screw indicator in its place putting paper on the indicator drum, n which paper two vertical lines are ruled.

Press the indicator pencil against the drum and draw a horizontal line at the point thus marked. Then set the poise of the scale at say 5 pounds and admit steam into the vessel gradually rising in pressure until the scale floats. When the pressure is exact draw the line R R and so on for successive pressures of 5 pounds, until the limit of the scale is reached. During this operation the motion of the indicator pencil is continuously kept upward, if at any moment the pressure rises too high, it is lowered by manipulating the valves below the required amount and then gradually raising to the desired point.

When the indicator pencil has reached its highest position, the steam pressure is allowed to fall gradually and a series of similar lines, as W-W, X-X, Y-Y and Z-Z drawn during the descent of the piston. The motion being continuously downward. The distance between any two of these lines as Y-R, Y-S, indicates the loss due to friction of the indicator.

The special advantage of this machine, besides its absolute accuracy, is that the indicator springs are tested in the individual indicator in which they are used and under actual steam pressure which is as near to the actual working conditions as possible. The indicator spring testing apparatus serves also for testing pressure gauges, which can be connected to the three openings in the front side of the vessel provided for that purpose, and the readings are verified by the indications on the scales and the test gauge shown in the illustration.

Sebco Mooring Bolt.

THE Sebco mooring bolts have been adopted by the Department of Docks and Ferries of New York City as the standard bolt for construction work in concrete. These bolts are specially devised for concrete construction. With the new way the Sebco mooring bolt is moulded in the concrete just where it is wanted. The bolts will not bend and the threads will not strip. You get the full strength of the bolt and can renew the bolt with any length desired at any time without redrilling holes. This new method saves the workman's time and labor and there is no loss of material.

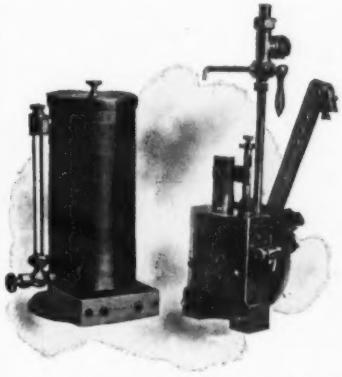
The Sebco mooring bolt is manufactured by the Star Expansion Bolt Co., of No. 147 Cedar street, New York City, who will gladly send full information and descriptive matter of this and other Sebco products illustrated in their catalogue to anyone addressing Catalogue Department 56.

Rochester Lubricator.

THE Rochester automatic lubricator is the pioneer in the force feed lubricator field. Its popularity is due to the following reasons:

It is absolutely positive, due to the fact that there is always under pressure a solid column of oil from the lubricator to the point of delivery; it will pump

against very high pressures even up to 1,500 pounds and over; due to the positive pump, the temperature makes absolutely no difference, as the same amount of oil will be pumped regardless of whether it is thick or thin; by means of three distinctly different methods of regulation, the amount of oil fed can be regulated so that the lubricator will feed anywhere from the smallest fraction of a drop to an almost continuous stream; the pump block is detachable making it



easy to clean or repair the lubricator; there is a double set of ball valves that prevent the clogging of the lubricator, each feed of every lubricator from the one-pint size up is provided with a patent combination multiplus sight feed and three-way cock; all lubricators from the one-pint size up are fully nickel-plated, and because of their appearance are an addition to any engine room; the lubricators are made in all sizes from one-pint to two-gallon and with any number of feeds from one to eight; by their use there is a great saving of oil, time and labor.

The manufacturers, Greene, Tweed & Co., 109 Duane street, New York, will be glad to furnish a complete catalogue to any interested inquirer.

Large Grinding Wheel.

WHAT is believed to be the largest vitrified grinding wheel ever made was recently turned out at the works of the Carborundum Company, Niagara Falls, N. Y. The wheel in question is made of Aloxite, the new steel grinding abrasive recently put on the market by the Carborundum Company. The big wheel is 48 inches in diameter and is to be used for tool grinding by one of the Carborundum customers in France.

Industrial Notes.

—The Stephens-Adamson Mfg. Co., Aurora, Ill., has recently strengthened their organization by securing the services of G. H. Stephens. Mr. Stephens has obtained substantial interests in this company, and has assumed the management of their entire eastern business. The eastern office is at 50 Church Street, New York City. Mr. Stephens has been a prominent factor in the conveying industry for over twenty years. He has a comprehensive knowledge of conveying and screening machinery and a wide acquaintance among the machinery users of the East. The Engineering Department of the New York office is under the charge of J. G. Macrum. Mr. Macrum was formerly associated with Mr. Stephens in business and is recognized as a conveying engineer of ability. Earl D. Stearns, who has ably represented the Stephens-Adamson Co., in the East for the past two years, has taken charge of the company's Chicago office in the First National Bank Building. The Stephens-Adamson Mfg. Co. are manufacturers of a complete line of conveying, elevating, screening and power transmitting machinery. Their main office and shops are at Aurora, Ill.

—H. M. Byllesby & Company of Chicago has acquired control of a number of additional public utility properties in California, including two important

water power developments and several water power sites not yet developed. The principal local plants purchased consist of the electric and gas properties formerly owned by the Stockton Gas and Electric Corporation, at Stockton; the electric light and power business at Richmond and the gas and electirc properties at Eureka. The American River Electric Company, which owns a large hydro-electric plant on the American River in Eldorado County, California, and maintains a reserve steam turbine plant at Stockton, is included in the transaction. The Humboldt Gas & Electric Company, operating at Eureka, possesses a considerable water power development in Trinity County, transmitting current to Eureka, 65 miles distant. The American River Electric Company's business includes service to Stockton, Placerville, Florin, Elk Grove, Sheldon, Gault, Lodi and Plymouth by means of long distance transmission lines, which are also extensively utilized for supplying power for gold mining and irirgation purposes. The Humboldt electric business includes service to the towns of Arcata, Alton, Ferndale, Fields Landing, Fortune, Hydesville, Loleta and Rohnersville. Eureka and surrounding towns have a population of 22,000. They are on Humboldt Bay which affords one of the few good harbors on the Pacific Coast. Back of the city lies an immense area of redwood forests. Eureka will soon be connected with San Francisco by a railroad line now under construction. Stockton with suburbs has a population of 30,000, is one of the oldest cities in California and is a manufacturing center of importance. Richmond, a newer town of 12,000 people, lies on San Francisco Bay south of Berkeley. It, also, is a manufacturing center and is the location of large new shops being built by the Pullman Car Company. All three cities have shown wonderful recent growth. A new company known as the Western States Gas and Electric Company, has been formed to hold the stock of the properties described.

—The firm of Dodge, Day & Zimmerman of Philadelphia, have added to their organization Walter Loring Webb and James M. Kennedy, well known in the engineering world. Mr. Webb is the author of several engineering textbooks, including "The American Civil Engineers' Pocket Book," "Economics of Railroad Construction" and "Problems in the Use and Adjustment of Engineering Instruments."

Obituary.

Louis R. Alberger, president of the Alberger Condenser Company and the Alberger Pump Company, 90 West Street, New York, died January 31. Mr. Alberger was one of the best known specialists in the country on pumping machinery and condensing apparatus. After attending Yale University he went in business with his father, who was engaged in the manufacture of vacuum process specialties used in the salt industry. In 1887 Mr. Alberger became connected with the Henry R. Worthington plant, afterward a part of the International Steam Pump Company. He left the Worthington organization in 1901, when he formed the Alberger Condenser Company and acquired the plant of the Newburgh Engine & Ice Machine Co. at Newburgh. Shortly afterward he formed the Alberger Pump Company.

George Q. Palmer, formerly vice-president, has been made president of the Alberger Condenser Company, and the Alberger Pump Company. Mr. Palmer is succeeded as vice-president in the Alberger Condenser Company by D. H. Chester, and in the Alberger Pump Company by W. S. Doran.